Design Engineering

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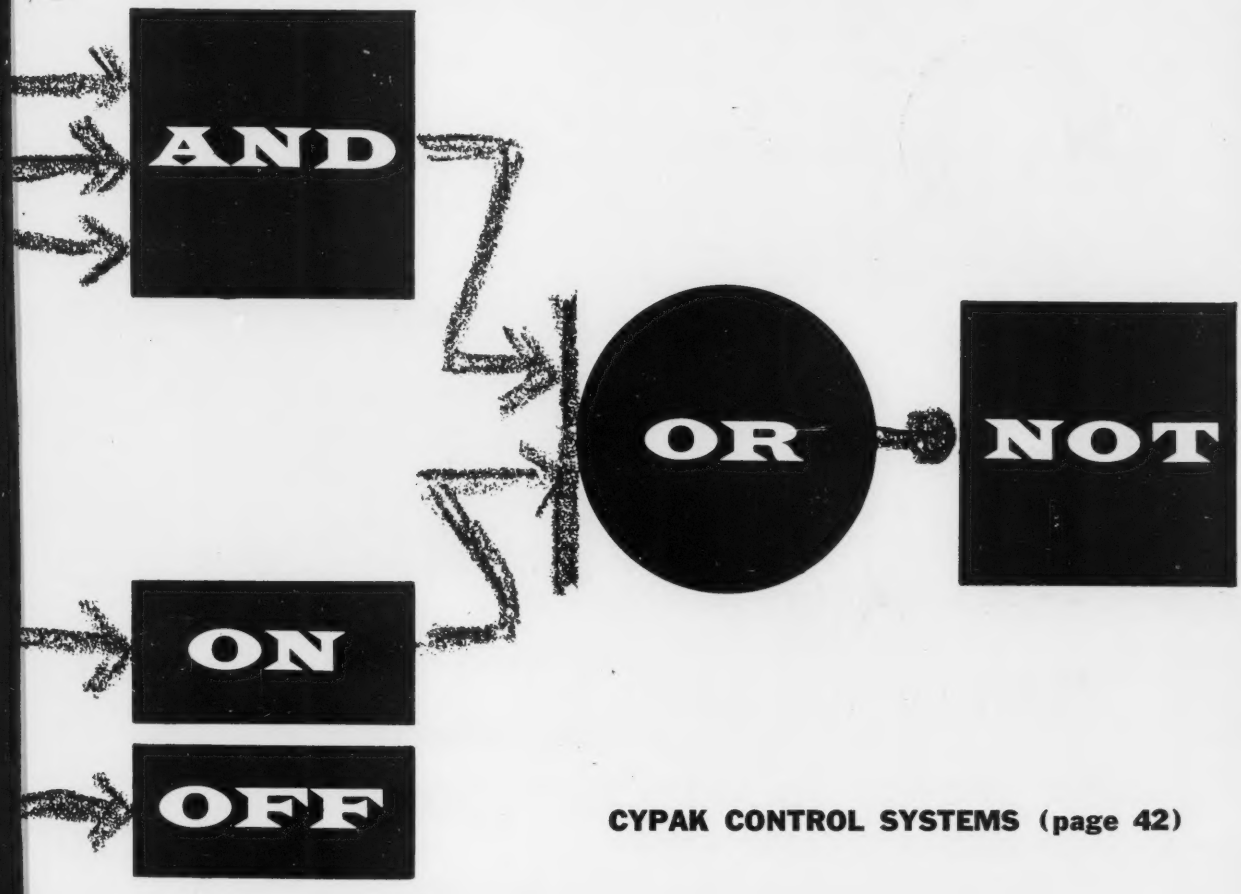
FEB 6 1957



CYPAK CONTROL SYSTEMS (page 42)

Use electronic stroboscopes for motion study

How to design safety valves

August 1956

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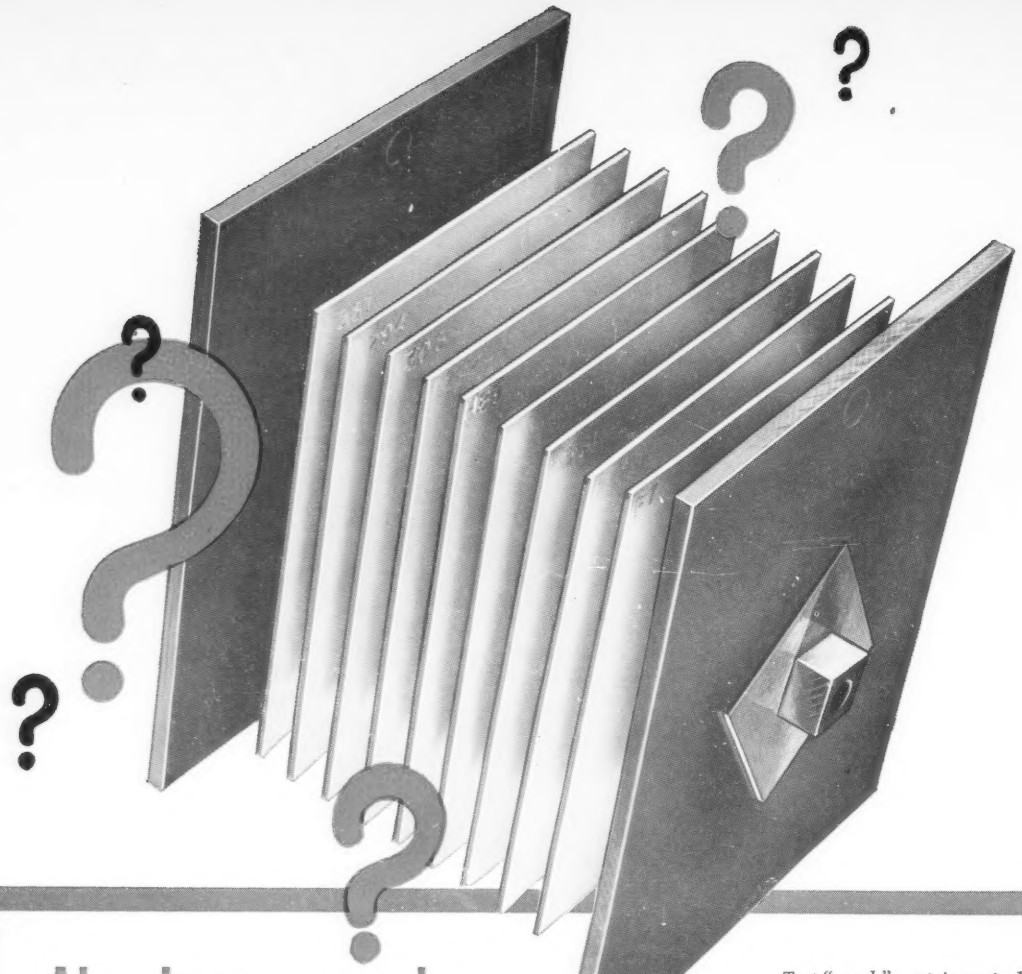

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Test "spools" contain up to 10 test panels and can be made any shape and size desired.

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This month's cover

What mumbo-jumbo is this? **And, or, not** indeed! Cybernetics engineers will, of course, know that they are the logic functions used in computer technology and in relays and switching circuits. The cover was prepared by artist Frank Davies to be symbolical of the story on Cypak systems. As you will find out from the story inside, these are made up of a number of basic elements, all without moving parts, which combine to carry out certain duties with reliability.

Design Engineering

MEMBER

CCAB

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Design Engineering

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RADAR NETWORK PERFORMER

The AVRO CF-100, with its superior armament, search and fire control system is the most potent aerial defender operating with the North American continent's Distant Early Warning and other Radar defenses.

Continuous development of the AVRO CF-100 through nine variants indicates its capabilities and versatility.

The current rocket-firing Mark 5 is providing improved bomber interception performance at higher altitude.

CF-100's will start augmenting RCAF NATO squadrons in Europe this year to help meet that Continent's night-fighter, all-weather defense requirements.

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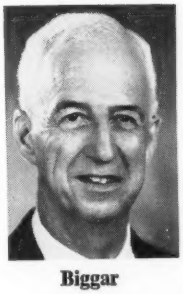
The **September** issue of **Design Engineering** will carry strong feature articles written by contributors no less experienced than those featured this month.

Be on the lookout for the article on die-casting design. A great deal of "know-how" must be applied before die-castings can spew from a machine at maximum speed. Another up-to-the-minute article shows how to know the type of phosphate coating you want. All too often, design engineers call for phosphating without first considering the most suitable type.

Orr

Rybb



Biggar

Dennis

The article on safety valve design was written by **James D. Orr,** a 1946 B.A. Sc. graduate of the University of Toronto. Before becoming an active member (5 years ago) of Orr Associates, he was in charge of mechanical design at the Ontario Research Foundation. Hobbies include reading and playing the trumpet, an instrument which he is still studying seriously in the hope of one day mastering it. At some future date he also hopes to design a trumpet on scientific principles rather than by the current rule-of-thumb methods handed down from father to son. He was recently elected chairman of the newly-formed society for design engineers.

The author of the article on electronic stroboscopes, **S. A. Rybb, B.Sc.,** is no newcomer to the pages of Design Engineering. His article on noise measurement in the March issue of this year went off with a bang and received wide acclaim. A graduate of London University in electrical engineering (1949) he is the chief engineer of Dawe Instruments Limited, Ottawa.

Possibly the most regular contributor to the pages of Design Engineering is **Percival Biggar,** contributor of the article on the XP 500 free-piston engine car. He is a recognized authority on automotive engineering and readers of Design Engineering should consider themselves fortunate to be getting the benefit of his wide experience in this field.

Readers of Design Engineering will doubtless be interested to know more about the new assistant editor, **John Wesley Dennis.** Educated in India and at Cheltenham College, where he was captain of rowing and a member of the college boxing team, he has been on the staff of News Letter, the house journal of the Manufacturers Life Insurance Company, first as editorial assistant and then as associate editor, since he arrived in Canada early in 1953.
Before coming here he worked for the Shell Petroleum Company, after a spell of national service with HM forces, where he rose from the rank of signalman to second lieutenant. Hobbies include sports cars (1952 Morgan sports and 1956 Volkswagen), photography, cartooning and—believe it or not—writing.

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Reports

News in brief from the world's producers

LONDON, ENGLAND—The third International Congress on high speed photography will be held this year from September 10 to 15.

High-speed photography and cinematography are rapidly gaining in importance in the fields of research and technology, where many problems are showing themselves to be most readily tackled by means of these comparatively new techniques. Much progress has been made in the scope of both techniques and application during the past ten years, and the most recent developments will be discussed and demonstrated during this Congress.

• • •

More technical books

DETROIT—A five-year book publishing expansion program has just been announced by the 34,000 member American Society of Tool Engineers.

In making the announcement, ASTE Executive Secretary, Harry E. Conrad, said, "The expansion of our handbook publishing activities represents another step forward in our planned schedule of increased services to industry and our membership."

The plans calls for publication of at least two additional major handbooks in the production and manufacturing field, as well as the undertaking of a three-year revision of The Tool Engineer handbook, which has sold more than 75,000 copies all over the world. A considerable number of shorter books (150-500 pages) is also scheduled.

• • •

Contract for antennas

GUELPH, ONTARIO—A new type of antenna design has landed a defense contract worth $61,755 for the firm of Valeriote Electronics Ltd.

It differs from other antennas because the spreaders and insulators are of fiberglas. Usually they are made of porcelain.

The antennas will be used on the Mid-Canada Line and have to be tough to cope with winds up to 140 mph and, for nine months of the year, the danger of heavy icing.

• • •

Joint drafting manual

NEW YORK—It has been announced that the Society of Automotive Engineers will produce and publish a drafting manual combining the best and most widely accepted drafting practices in the aeronautical and automotive industries.

The importance of such a project can be appreciated when it is realized that drafting is the means by which engineers record their creative ideas and communicate them to the factory for manufacture. By establishing standard drafting terminology and techniques, much clearer and cheaper communication between engineers will be possible.

Agreement of the ground vehicle and aircraft industries on a single set of drafting standards will be an important step toward national and international unification of drafting practices.

• • •

National office in Ottawa

SASKATOON—A national office is to be established in Ottawa by the 30,000 member Dominion Council of Professional Engineers, it was announced at the annual meeting of the Council held recently.

The new president of the Council, which represents the 11 provincial engineering associations (including the Yukon) is E. J. Durnin, P.Eng., of Regina. He succeeds George P. Demers, P.Eng., of Quebec City. Other members of the Council's executive are: C. N. Murray, P.Eng., Sydney, N.S. (vice-president); Prof. W. O. Richmond, P.Eng., Vancouver (executive member); and J. Murray Muir, P.Eng., Toronto (secretary-treasurer of the APEO).

The meeting saw the circulation of a brief to all councils on the plan for unity which would provide a confederation of all engineering bodies in Canada. After consideration by them, the brief will be studied by a special committee for further action.

Other matters discussed at the three-day meeting included consideration by each of the provincial associations of changes in their respective legislation and the existing federal legislation governing the free entry into Canada of engineering plans from other countries.

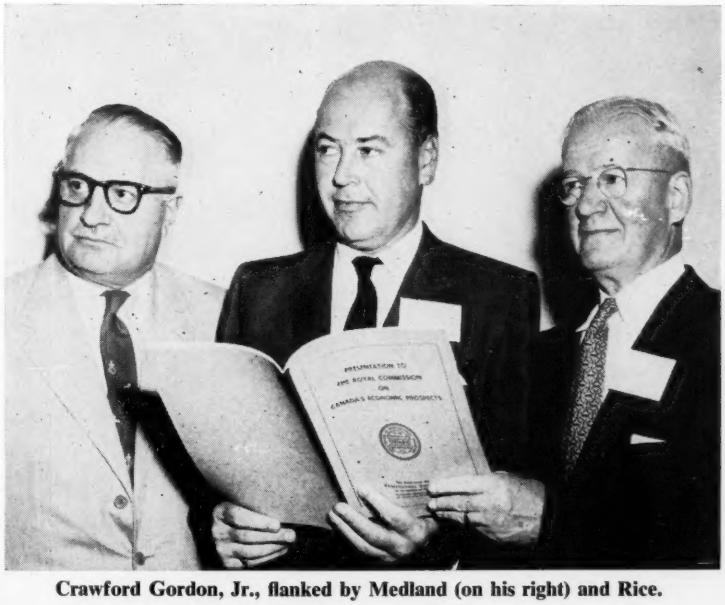
Newest member of the Dominion Council is the Association of Professional Engineers of the Yukon Territory, represented at the meeting by Lt.-Col. M. C. Sutherland-Brown, P.Eng., Whitehorse (provisional vice-president).

It was announced that the 1957 meeting of the Dominion Council will be held in Nova Scotia, the actual meeting place to be announced later.

• • •

Manpower shortage

TORONTO — A national conference on scientific and engineering manpower, aimed at finding a solution to the existing acute shortage of scientists, professional engineers and skilled technicians, is to be held on September 10-11. Announcement of the conference, which will see the participation of some 50 leading Canadians in the fields of education, government, the professional societies, labor and industry, was made recently by Crawford Gordon, Jr., president of A. V. Roe Canada Ltd., at the annual meeting of the Canadian Manufacturers' Association held in Toronto.



Crawford Gordon, Jr., flanked by Medland (on his right) and Rice.

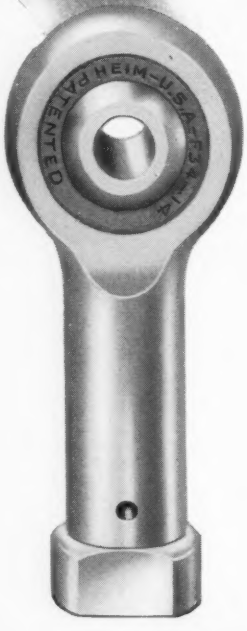
THE SURPRISINGLY VERSATILE

Would You Spend 30 cents To Save a Dollar?

HEIM Unibal

HAS MANY USES OTHER THAN STRICTLY ROD END APPLICATIONS

Depending upon size and quantity, some HEIM Unibal Spherical Bearing Rod Ends cost 30¢—even as low as 26¢ each. More and more manufacturers are discovering that a Heim Unibal can very often replace a special part, a weldment, assembled screw machine parts, or other specially machined component . . . which may have cost over a dollar to produce. Savings effected have run into substantial sums.

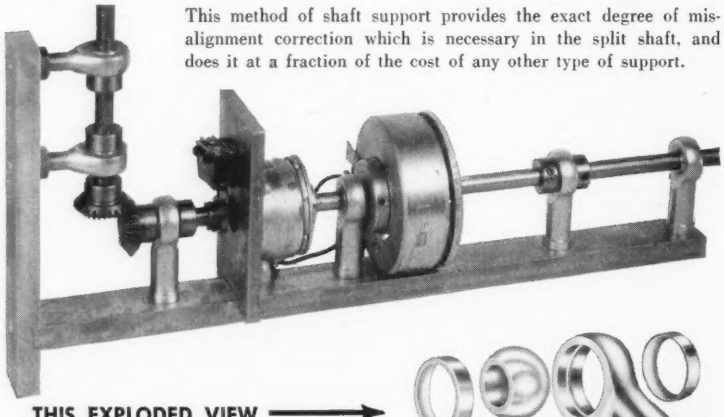


Take this clutch assembly

with its split shaft and bevel gears, as used in the Van Buskirk marking machine, as an example of how these inexpensive Heim Unibals act as adjustable, self aligning supports for both the horizontal drive shaft and the vertical driven shaft.

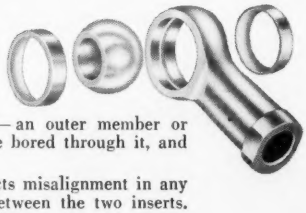
The drive shaft is supported by four female Heim rod ends, which are attached to the frame with hex-head bolts through drilled holes. The assembly is that simple.

The vertical shaft is held in place by two male Heim rod ends. These are screwed into drilled and tapped holes and locked in place with nuts and lock washers.



This method of shaft support provides the exact degree of misalignment correction which is necessary in the split shaft, and does it at a fraction of the cost of any other type of support.

THIS EXPLODED VIEW ⟶



shows the components of the Heim Unibal—an outer member or body, a hardened and ground ball with a hole bored through it, and two bronze bearing inserts.

The universal motion of this single ball corrects misalignment in any direction. Lubrication is in the groove left between the two inserts. Grease fittings can be supplied for relubrication.

Unibal presents a larger bearing surface and can support greater axial and thrust loads.

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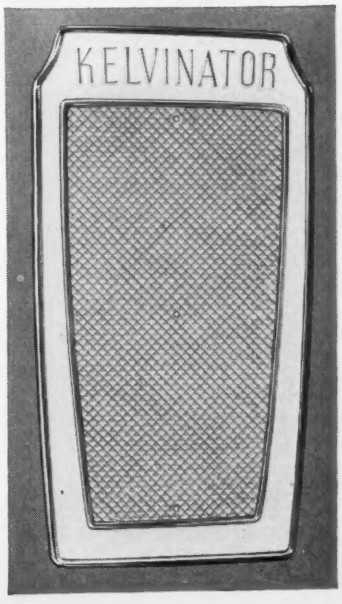
PRODUCT ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

KELVINATOR *parts moulded of* LUCITE *by* ONTARIO STEEL PRODUCTS *prove decorative and functional.*



When Kelvinator of Canada and Ontario Steel Products Company Limited got together on a problem involving parts for the 1956 line of Kelvinator refrigerators, their thoughts naturally turned to LUCITE acrylic resin.

The parts involved were a scuff plate used behind the handle on the outer door, and a name plate for the freezer compartment door.

LUCITE, a product which combines remarkable beauty with outstanding functional properties, was tailor-made for the Kelvinator requirements. Its excellent chemical resistance and form stability will keep these parts attractive during the entire life of the refrigerator.

Ontario Steel Products, combining many years' experience with LUCITE along with the most advanced moulding and vacuum metallizing facilities, have produced mouldings of the highest quality of workmanship.

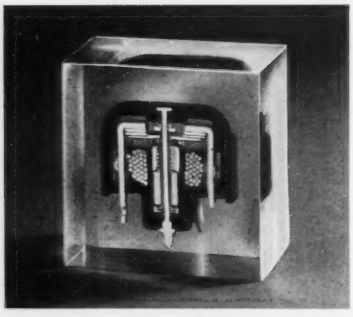
Your problem in design may well be solved by LUCITE. Available in forms suitable for extrusion as well as moulding, this material is now finding new and exciting uses in the lighting industry. Write for further information on this development.

DU PONT CANADA

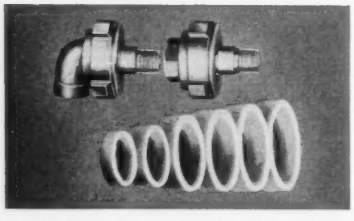
PRODUCT ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

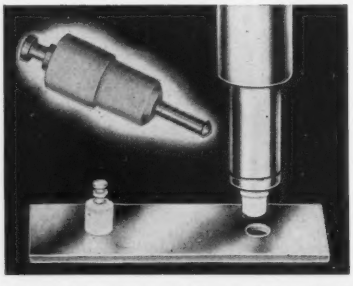
5 examples of how Du Pont engineering materials help solve design problems



LUCITE® acrylic resin adds beauty and durability to embedments, which have a variety of uses. Small items such as electrical components or intricate mechanisms, as well as miniatures of larger products, can be embedded in the "Lucite" either singly or in patterns giving exploded-view effects. These miniature sales showcases can be handled indefinitely without growing grimy and losing their functional and promotional value. (Embedments shown made by Plastic Developments, Inc., Attleboro, Mass.)



TEFLON® tetrafluoroethylene resin in gaskets for swivel joints is without equal for long wear and trouble-free service. Joints maintain their seal under the most adverse conditions. They excel in steam service, perform uniformly within the temperature range of −50°F. to 450°F., are smoother, tougher, and longer wearing—no lubrication ever needed. (Swivel joints by Barco Manufacturing Co., Barrington, Illinois.)



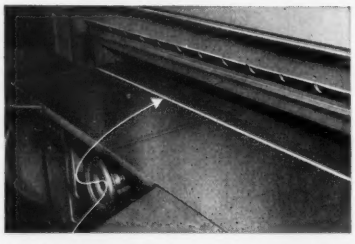
TEFLON® tetrafluoroethylene resin is utilized in miniature and subminiature stand-off and feed-through terminals. They cost less than conventional glass or ceramic terminals, and they offer further economy in reduced labor and assembly time.

These terminals of "Teflon" are of a molded, one-piece construction, and can be simply and permanently mounted into chassis holes by press-fitting, using an inexpensive insertion tool. The resiliency of "Teflon" enables these terminals to be pressed in place for rigid and permanent installation without requiring any soldering operations or any other hardware.

The superior electrical, mechanical and chemical properties of "Teflon" further increase the range of application for these miniature terminals. They are tough and remain resilient over a temperature range of −100°C. to 250°C. Dielectric strength of "Teflon" is high over a considerable temperature range. "Teflon" is chemically inert to any known solvents, acids or bases. Terminals can be used in military equipment for tropical use, without additional fungicidal treatment. Terminals will not melt, burn or char. ("Press-Fit" terminals manufactured by the Sealectro Corp., New Rochelle, N.Y.)

These applications are typical of the product improvements made possible when design and service requirements are evaluated in terms of the properties of these unique engineering materials. For further information, mail the coupon below.

ZYTEL® nylon resin is the only material used in the Nylon-Maid shower heads. The inherent chemical resistance of "Zytel" enables these shower heads to function without danger of corrosion. They are easily installed and adjusted. Shower heads of "Zytel" are tough, resilient, and heat-resistant. They offer years of trouble-free service. (Shower heads by Nylon-Maid, Inc., Glendora, California. Parts of "Zytel" by Rainbow Plastics, El Monte, California.)



ALATHON® polyethylene resin has replaced wood in the sticks which act as a knife stop for this paper cutter. The life of "Alathon" is six times greater than that of wood, and tests have shown that the cutting knife will last twice as long when "Alathon" is used. It provides savings in costs and down time. (Cutting stick by Cefaly Experimental Co., Inc., Brentwood, Maryland.)

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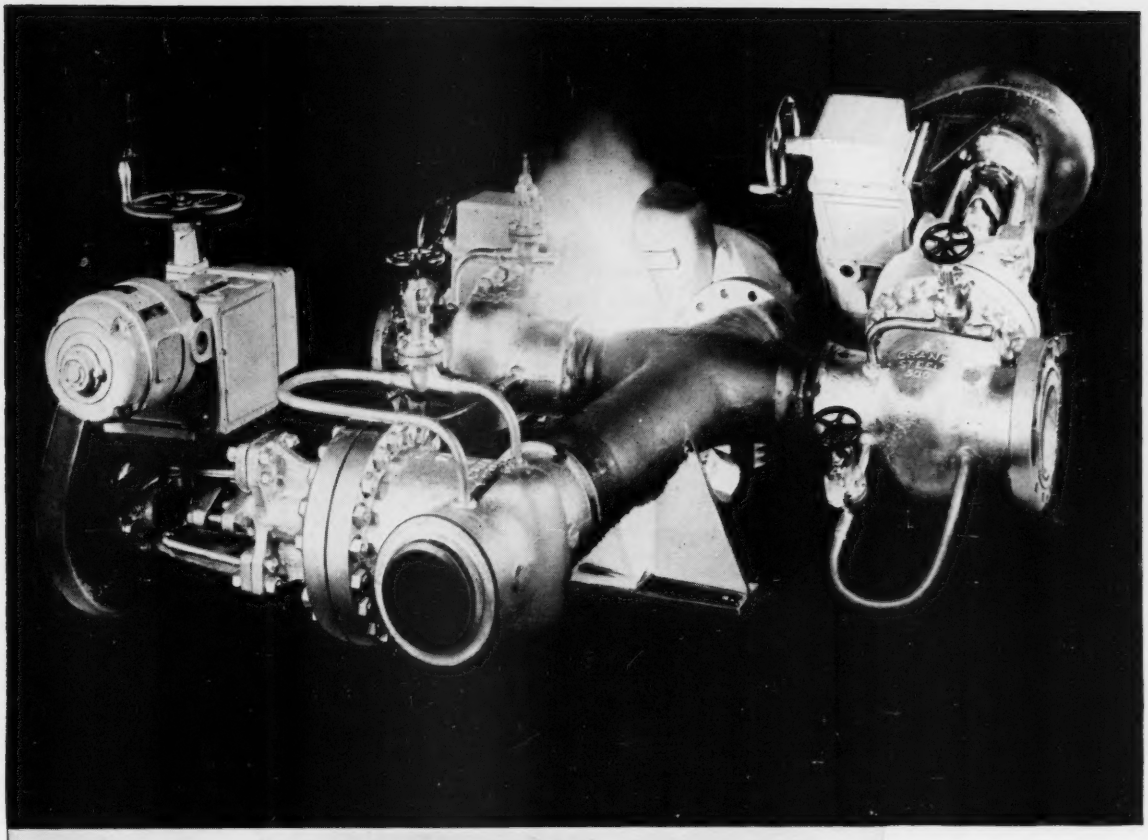
One of the family of these versatile engineering materials is often a key factor in product improvement or new product design. The wide range of properties available with "Alathon"* polyethylene resin, "Lucite"* acrylic resin, "Teflon"* tetrafluoroethylene resin, and "Zytel"* nylon resin are helping solve industrial design problems.

NEED MORE INFORMATION? Clip the coupon for additional data on the properties and application of these Du Pont engineering materials.



What's CRANE cooking up here?

Big Piping Savings for You...

The man behind the mask above is a *unit fabrication* specialist with a talent for saving you time, trouble—and dollars—in the long run.

He's part of a crew of experienced mechanics in the Crane Pipe Shop, where piping units like this 8-inch assembly are built *precisely* to specification.

And it's a complete as well as a quality service, for Crane takes over at the blueprint stage; supplies all valves and component parts—makes the pipe bends—does the welding. Right at hand are the best facilities for heat-treating or stress-relieving, radiography, etc., to assure uniform strength and dependability. The finished unit is pre-tested and proved in advance, ready for quick installation in your piping system.

You take no risk—you pay for no spoilages, and your erection crew is spared many a major headache. Why not let your Crane representative review your piping layout and help you decide where Crane Unit Fabrication will be to your advantage?

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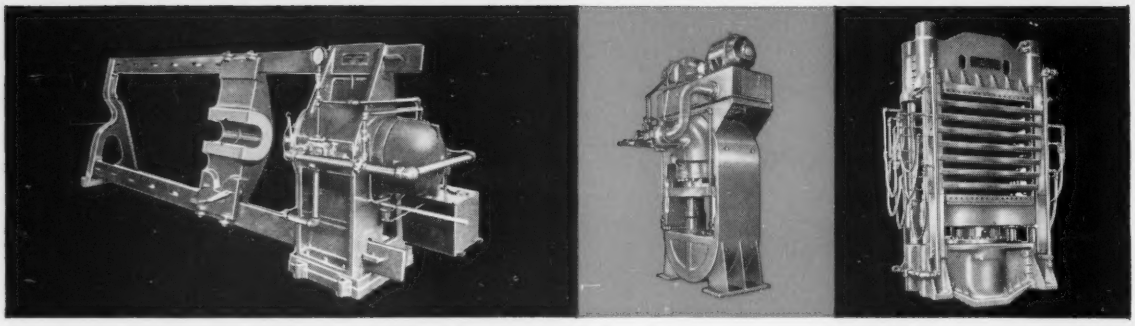

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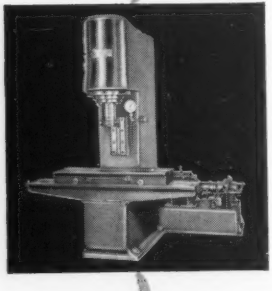

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THE LATEST NEWS ON SIMPLIFYING DESIGN

Versatile Vulcanized Fibre by National reduces cost of dies and molds and simplifies parts for fast assembly.

Today's big news in product design is *simplification* through the use of molded plastic parts. But molding may not be your best answer. *Formed fibre* is often a cheaper—and better—solution!

Look to National Vulcanized Fibre as an engineering material with these advantages:

Lower die or mold costs

Excellent forming qualities

Greater durability—toughness plus resilience

Good heat resistance and dimensional stability

Low material cost

National Vulcanized Fibre and its unique combination of mechanical and electrical properties suit this lightweight, low-cost material to hundreds of difficult applications. And National's generations of experience can always be tapped for answers to your problems.

The typical examples on this page show what can result when our skilled technicians apply versatile vulcanized fibre to your particular job. Consult your nearest National representative about your current materials problem—or write Wilmington, Delaware, Dept. N-8.

NATIONAL

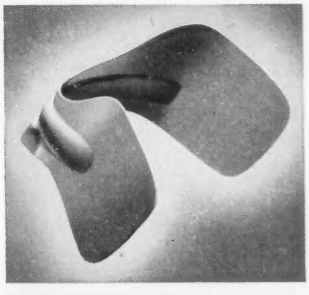
FIBRE COMPANY OF CANADA. LTD.

ATLANTIC & HANNA AVENUES, TORONTO

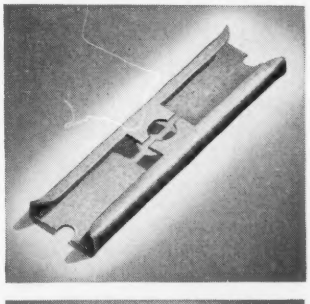
1411 CRESCENT STREET, MONTREAL

VULCANIZED FIBRE • PHENOLITE LAMINATED PLASTIC • PEERLESS INSULATION
KENNETT MATERIALS HANDLING RECEPTACLES • VUL-COT WASTEBASKETS
LESTERSHIRE TEXTILE BOBBINS • VULCOT PRODUCTS FOR THE HOME

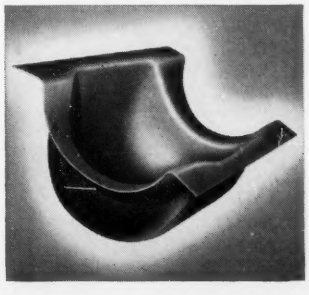
John Macadam, one of National's staff of applications engineers, displays example of the forming versatility of vulcanized fibre.



Drawn and formed in one operation, the hip guard shown here possesses the resilience, toughness and shape retention that make vulcanized fibre the most used material for protective athletic equipment. Channel draw strengthens structure yet retains necessary spring. The piece is dipped, then baked with synthetic enamel for moisture protection and good appearance.



Punched, formed, scived and flared, this insulator component shows the successful solution of a difficult problem—boxing a channel on all four sides. In fabricating, the blank of vulcanized fibre was first cut to contour, after which the ends were scived, then formed into a box section and flared. This combination of operations makes the piece unusual.

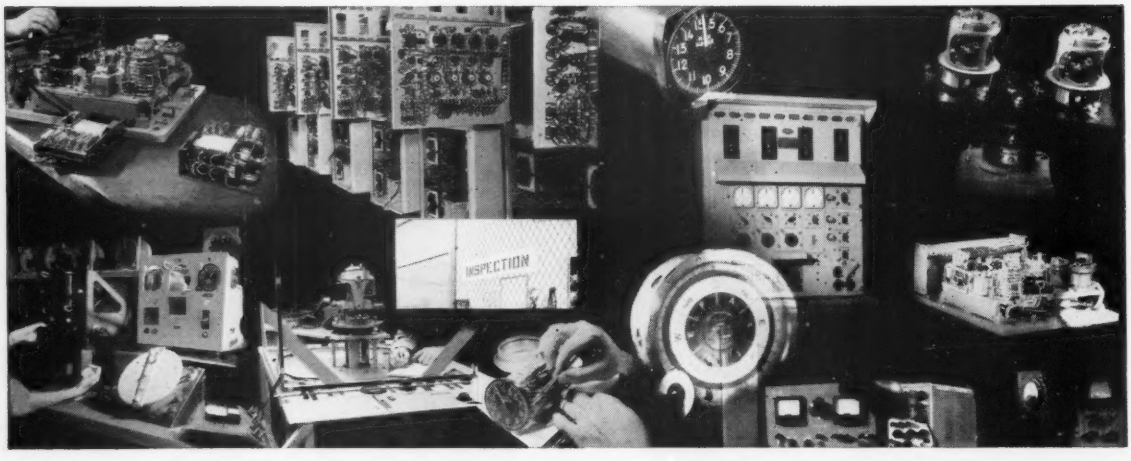


Formed and deep drawn to a depth of 7 inches, this welder's helmet demonstrates the extreme workability of vulcanized fibre. Fabrication was by a single draw with an open bottom die—i.e., fibre was pulled in four different directions. Drawing depth and radii curve are about the maximum limit.

SPERRY

experience to plan

Long experience in solving problems relating to automatic control methods; places Sperry in a unique position to work with Canadian industry on projects involving new lines of research. To meet a critical need with a practical solution is part of the everyday work of the Company.
A specially trained staff of development engineers is always at your service.



ability to build

The modern Sperry plant was conceived, built and equipped as a complete unit. From the first day of its operation its full facilities were put into use and a natural flow of processes followed. This made possible an intensive supervision of every operation so that engineers might apply their skills to best advantage. The result of this is the ability to build with accuracy and precision and at costs within the framework of good business.

If there is a solution to your industrial control problems, you'll find it at Sperry.

SPERRY

SPERRY GYROSCOPE COMPANY OF CANADA, LTD.
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Mr. Perkins had a problem

50 YEARS AGO Perkins' problem was rife in Canada. It affected business, industrial and professional circles alike. It was the need of specialized information and guidance in any particular field. In short, it was the need of business papers.

Perkins' problem does not exist today. Every branch of Canadian business, industry and the professions has its own specialized publication. Problems are pin-pointed—questions answered—new and unfamiliar subjects expertly discussed. The importance and strength of these papers was recently confirmed by a Gruneau Research programme. It was found that 86.3% of Canadian business, industrial and professional men subscribed to business papers. This is only ONE significant fact unearthed by Gruneau. The complete report is available to you, free. Send for your copy today.

This paper is a business paper. One of over 100 business, industrial and professional publications each of which is a member of the Business Newspapers Association of Canada, 137 Wellington Street W., Toronto, Canada.

BNA

When you want to sell to business advertise in business papers

There's more in this barrel than just a chemical

YOUR BIGGEST DOLLAR'S WORTH!

Excellence of product, excellence of service, and the experience, ingenuity and dedication of the organization make Parker surface treatments for metals the biggest dollar's worth in the field!

● The formulation is important in surface treatments for metals. Of equal importance, our customers tell us, are the extra services and qualities that are part of what you get with every barrel of a *Parker* surface treatment chemical.

There's over 40 years of *experience* in every Parker barrel . . . *engineering service* (without charge) to help fit the process into your plant . . . *fast availability* from plants located coast-to-coast . . . *experienced technical help* (Parker service men average over 12 years on the job) . . . continuing *research* which has pioneered developments in the field . . . *quality control, process lab* and *test facilities* which work to help customers improve their products.

For the finest metal surface treatments, plus all these advantages, call in the Parker man in your territory.

**Bonderite, Bonderlube, Parco, Parco Lubrite, Parker Pre-Namel – Reg. U.S. Pat. Off.*

PARKER RUST PROOF CO. OF CANADA LTD.
REXDALE BLVD., REXDALE (TORONTO) Ont.

Since 1914 — leader in the field

BONDERITE	BONDERITE and BONDERLUBE	PARCO COMPOUND	PARCO LUBRITE	TROPICAL
corrosion resistant paint base	aids in cold forming of metals	rust resistant	wear resistant for friction surfaces	heavy duty maintenance paints since 1883

G-E CARBOLOY THERMISTORS...
offer detection, measurement and control of energy to a degree Never Before Practical...

G-E CARBOLOY THERMISTORS are circuit elements with a highly sensitive response to minute changes in temperature. They have a negative coefficient of resistance — *resistance decreases with increased temperature* — and, their temperature coefficient is much larger than that of any other known material. These features, coupled with excellent stability and aging resistance, offer industry and science the opportunity to detect, measure and control energy to a degree never before economically possible.

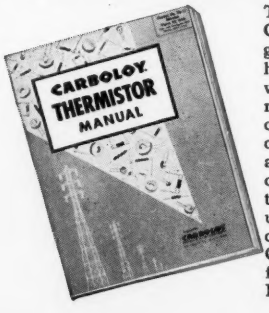
Carboloy Thermistor applications can be divided into two broad classifications, depending upon the operating characteristics of the element used and the functions performed. These are determined by whether: (1) the element is controlled by ambient temperature; or (2) the element is heated by the current in the circuit with which it is associated. The first includes applications involving temperature measurement and control, and temperature compensation. The second, covers uses involving voltage-current and current-time characteristics; such as time delay devices for relay operations, timing devices, sequence switching, safety and warning circuits, voltage regulators, flow meters and vacuum gauges.

✓ CHECK THESE FEATURES

1. **A large negative temperature coefficient of resistance.**
2. **Response to minute temperature changes.**
3. **Permits local or remote temperature measurement.**
4. **Offers temperature control never before practical.**
5. **Can eliminate mechanical timers.**
6. **Can eliminate current surge in electrical circuits.**
7. **May be used with electrical conductors to compensate for changes in their resistance due to temperature changes.**
8. **Will reduce cost, size and weight of products and processes.**
9. **They last indefinitely — need no maintenance.**

CARBOLOY THERMISTORS

Free Technical Manual Gives Application Data and "Ideas"



This free technical book, Carboloy Thermistor Manual, gives extensive information helpful to persons concerned with the design or improvement of products and processes. It includes basic circuits and performance curves, and "idea" circuits, with curves, are provided as a guide to the best utilization of the unusual operating and physical characteristics of G-E Carboloy Thermistors. Write for this 56-page manual today. Mail the coupon below.

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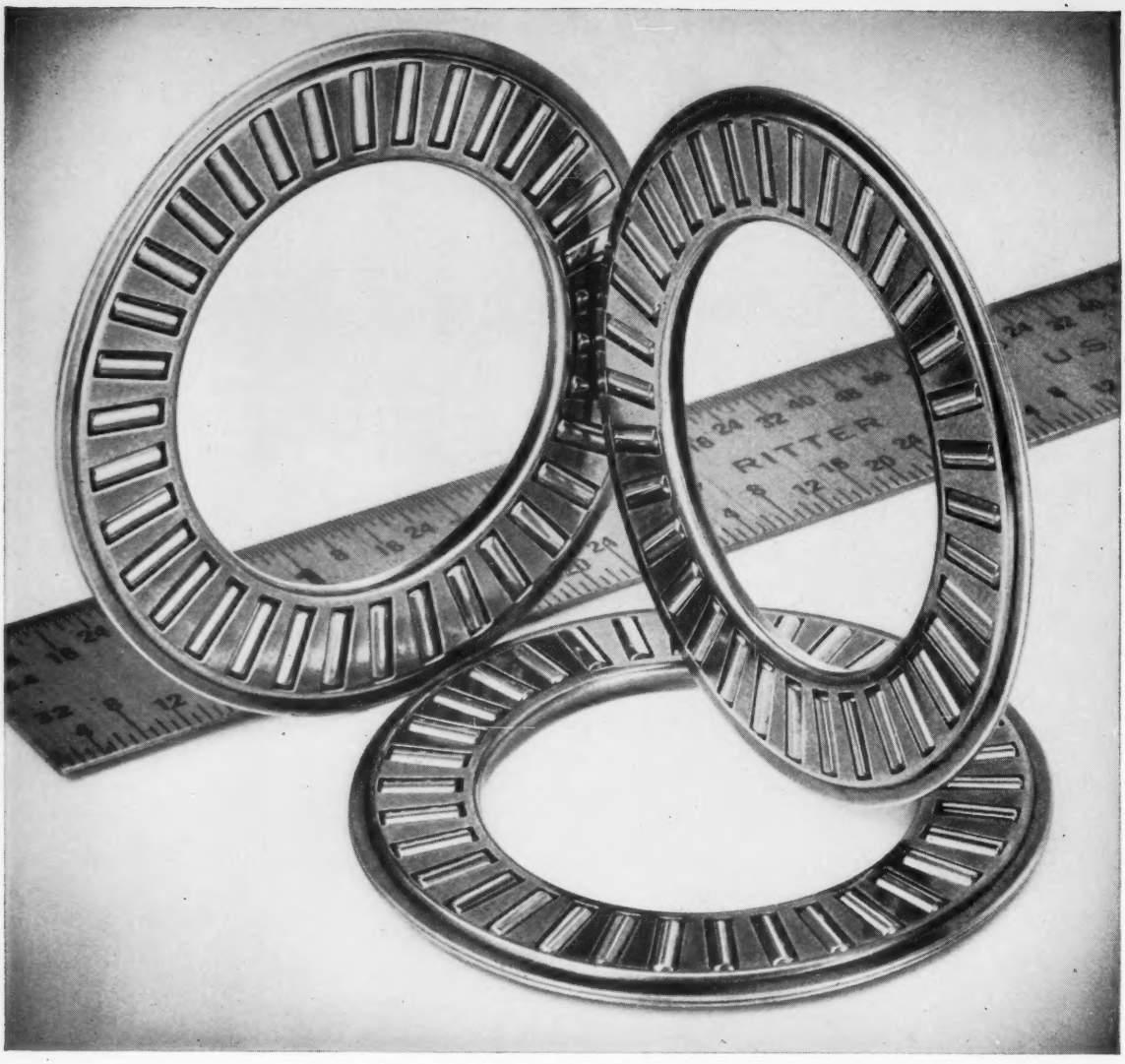
CANADIAN GENERAL ELECTRIC COMPANY LIMITED



Here's the **NEW** Torrington Needle **THRUST** Bearing!

Now designers have available a *needle bearing* exclusively for heavy *thrust* loads.

This compact Torrington Needle Thrust Bearing—only .0781" in cross section—is no thicker than an ordinary thrust washer. Yet it brings all the advantages of anti-friction operation at low unit cost for many thrust applications.

Two mating retainer halves, highly accurate steel stampings, are securely joined to form a self-contained unit closed on OD and ID. The bearing can run directly on adjacent parts, hardened to act as races, or on economical hardened and ground flat races. The bearing is piloted on the retainer bore.

In any thrust application where low unit cost, high thrust capacity and compact design are primary factors, consider the Torrington Needle Thrust Bearing. Services of our Engineering Department are available to assist you with design and application.

Send for our new Bulletin, "No. 16—Torrington Needle Thrust Bearings," for full information.

Highly successful applications of the Torrington Needle Thrust Bearing have been made in automatic transmissions, governors, steering gears, bevel gears, hydraulic pumps, and torque converters.

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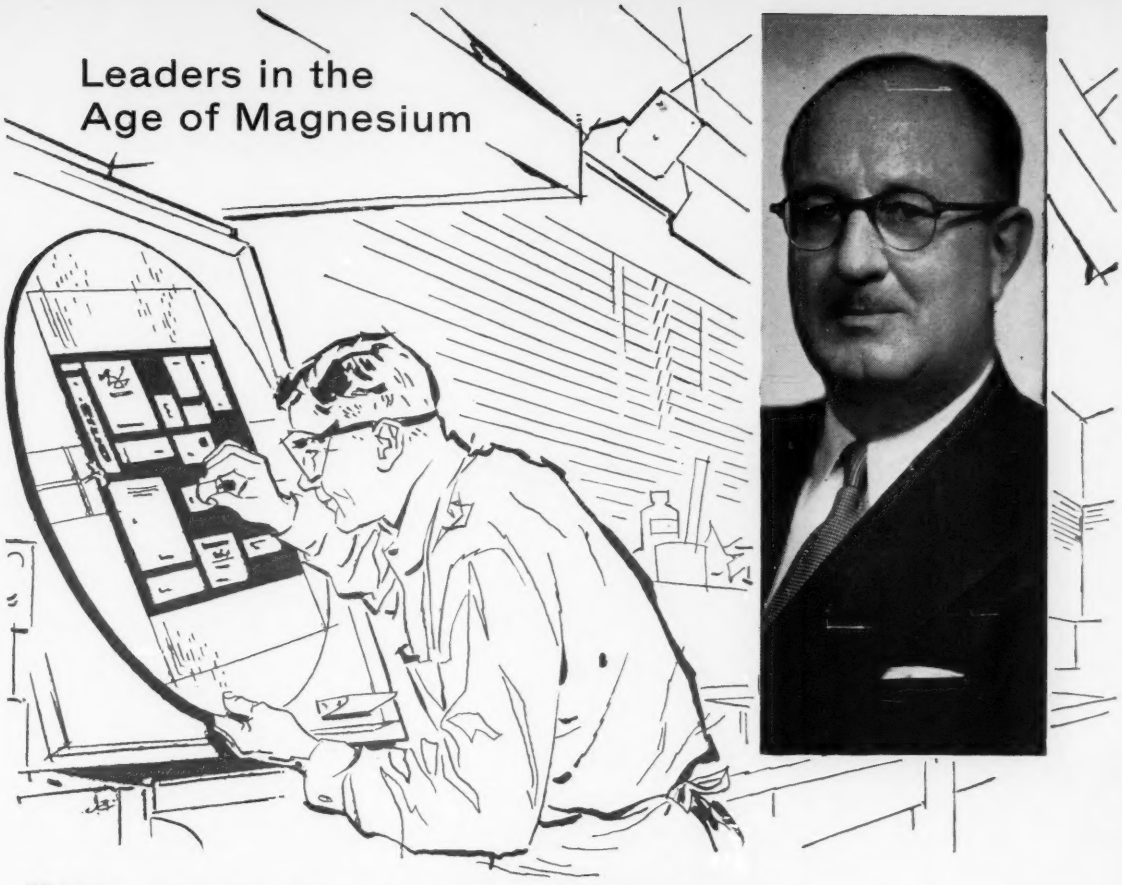
Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers



"We have based our future on
MAGNESIUM

"We at Brooks and Perkins based our future on Magnesium a good many years ago. We have prospered. We have found that Magnesium will do a job in economic competition with other materials in a hundred different ways. Not only have our fabricating plants in Detroit been expanded, but we were able to install our own rolling mills in nearby Livonia. Metal dealers warehouse our products, and we have offices in New York, Washington, Los Angeles and Dallas.

"Domal High Purity Magnesium is contributing to the success of Brooks & Perkins' Magnesium Printing Plates. Our Magplate Division tells us that its high quality and uniformity gives almost as much advantage over our earlier plates as magnesium has over other metals.

Extract from a letter by Mr. Howard Perkins, President, Brooks and Perkins Inc., Detroit, Michigan.

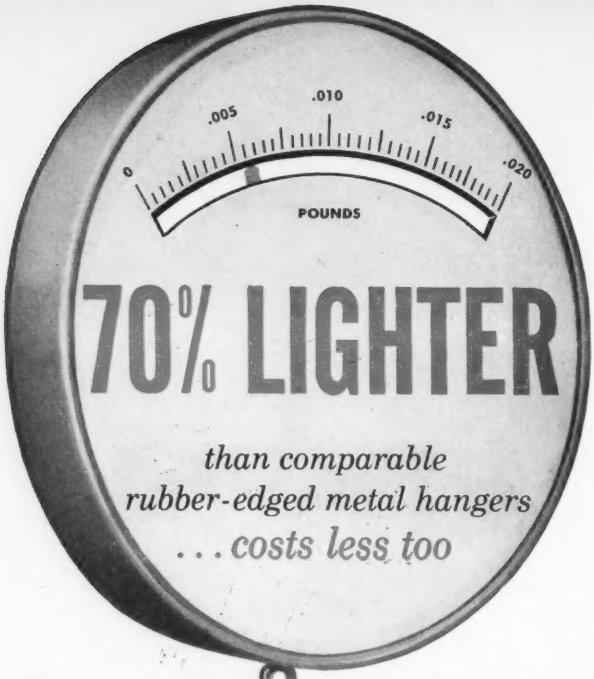
DOMAL
HIGH-PURITY
MAGNESIUM

THE WORLD'S LIGHTEST, MOST VERSATILE METAL

DOMINION MAGNESIUM LIMITED

320 BAY STREET · TORONTO, CANADA

The original engravings for this advertisement were made on magnesium



70% LIGHTER

than comparable rubber-edged metal hangers ... costs less too

NYLOCLIP T.M.

NYLON CABLE HANGERS

For strong, sure support ... for sustained periods in temperature extremes from −60°F to 250°F ... these new, tough, lightweight, molded nylon cable hangers give you all the important features of metal, *plus.*

Even under severe stress, NYLOCLIP's high physical strength holds pre-formed shape indefinitely ... undamaged by oils, gasoline, alcohol, hydraulic fluids.

Self-insulating nylon is high dielectric non-conductor; eliminates hysteresis losses, grounds, shorts.

Cable insulation fully protected by rounded edges, matte finish inside surface of NYLOCLIP. Stud hole serrations running parallel to cable insure automatic alignment when screw is tightened – prevent cable chafing. Available in 17 standard sizes to accommodate cables or bundles from ⅛" to 2".

Meets MIL-STD-242 and NAVORD OSTD 600-7-3.02.29 (int.)

For proof of performance, send for samples... to your specified sizes.

rugged strength of Nyloclip supports this man's full weight ... 247 lbs.!

56-10

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Does your Industry fit into the BAKELITE TRADE MARK Polyethylene picture?

A few of the present products made from "Bakelite" POLYETHYLENE are illustrated in this advertisement. These products are examples of the characteristics that "Bakelite" POLYETHYLENE offers such as flexibility, light weight, resistance to heat and cold, high impact strength, good electrical properties, resistance to grease, most acids and moisture.

Plan your future products in terms of "Bakelite" POLYETHYLENE to be sure of top quality.

Write for full information about "Bakelite" POLYETHYLENE to Dept. D.E. 6-8

"Bakelite" is a registered trade mark

BAKELITE COMPANY

Division of Union Carbide Canada Limited

UCC

BELLEVILLE, ONTARIO

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40 St. Clair Ave. East, Toronto 7
Telephone WAlnut 4-2119

Sales Office:
1425 Mountain Street, Montreal 25
Telephone HArbour 3145

This is a Tycoon
(in a receptive mood)

who knows what he wants
(quality machined castings)

when he wants it
(the day before yesterday)

and how to get it
(from Wallaceburg, naturally)

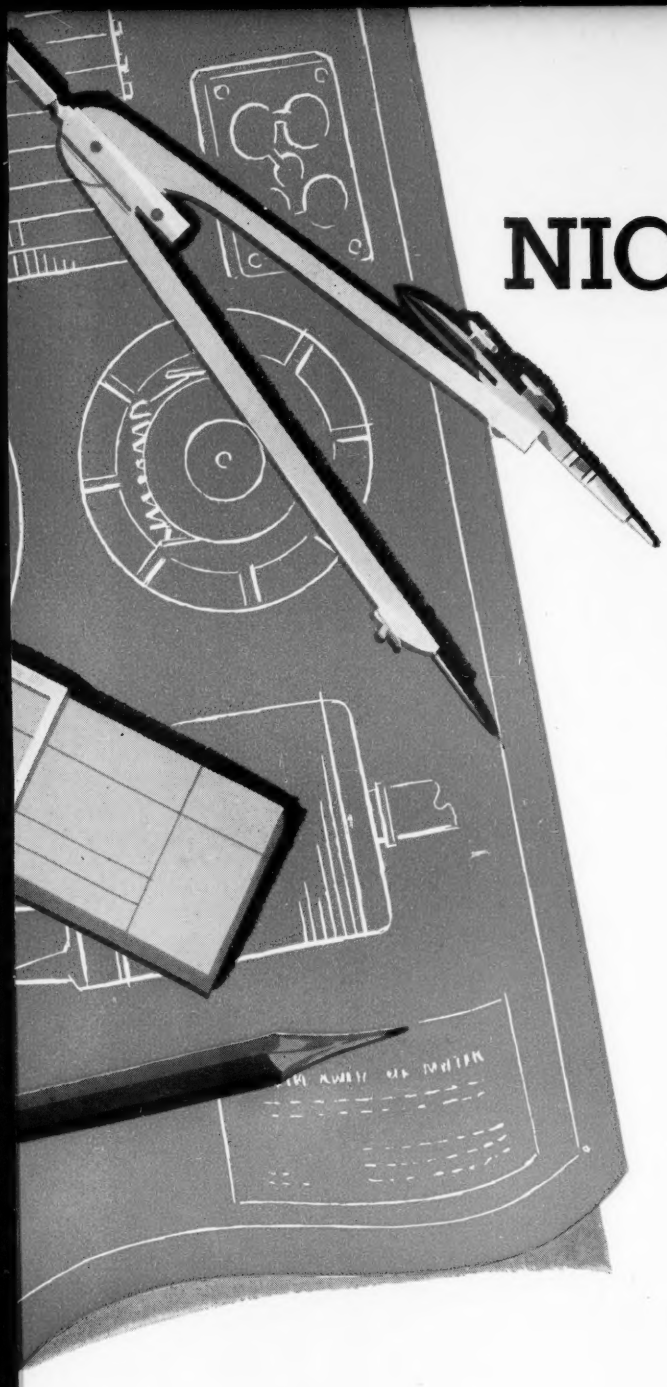
The day before yesterday is difficult, but Wallaceburg has sometimes worked *near* miracles for customers. For fifty years, hundreds of leading Canadian businesses have been calling in the man from Wallaceburg to supply component parts. For two very good reasons—quality and service. Fast, dependable, complete service.

Now, with Wallaceburg-Singer Limited, producing Cored Brass Forgings, we've more than ever to offer. Call us for Die Castings in zinc and aluminum, Machined Sand Castings in brass and bronze, Cored Brass Forgings and Automatic Screw Machine Products in brass, steel and aluminum. **And because we have all these processes, we'll honestly and intelligently tell you which is right for your component.**

WALLACEBURG
BRASS LIMITED
WALLACEBURG, ONTARIO

AND AFFILIATED COMPANIES
WALLACEBURG-SINGER LIMITED
DOMINION DIE CASTING LIMITED

BRANCHES: MONTREAL, TORONTO, MONCTON, LONDON, WINNIPEG, CALGARY, VANCOUVER



Design with NICKEL STEEL for improved mechanical properties

Nickel is being utilized to assist the design engineer in an ever increasing variety of equipment. It is used extensively in the direct-hardening engineering steels where it greatly improves mechanical properties. Also the nickel-containing carburizing steels are favoured because they distort less in heat treatment and perform better in service, particularly when heavy loads are encountered.

Increased Corrosion Resistance

Proprietary brands of the weldable, low-alloy high-strength steels usually contain nickel. Such steels allow for weight reduction because they have higher yield points than the weldable grades of unalloyed steels. These materials also have better resistance to the corrosion effect of atmospheres than do the weldable grades of unalloyed steels.

Strengthens Matrix

To obtain proper mechanical properties in large forgings is much more difficult than it is in the case of the smaller sections usually involved in rolled steel applications. The properties of large forgings are therefore dependent on the alloy content. Nickel, either alone or in combination with other elements, has been the leader in this field because it strengthens the matrix, independent of the carbon content or heat treatment.

Increases Toughness at Low Temperature

Nickel definitely lowers the temperature at which brittle failure occurs in steel and is certainly the most potent element in this ability.

Many designers probably are unaware of the fact that good low temperature properties also indicate the suitability of a steel for use at ordinary temperatures under conditions of high stress concentration or rapid rates of loading.

EMBLEM OF INCO SERVICE TRADE MARK

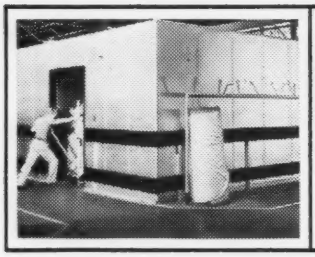
THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED

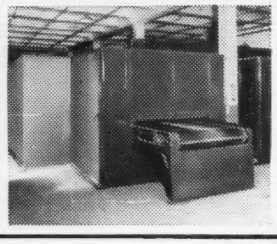
25 KING ST. W., TORONTO, ONTARIO

There's no Limit

to what you can "house" with

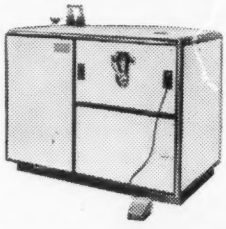
LINDSAY PREFABRICATED ASSEMBLIES

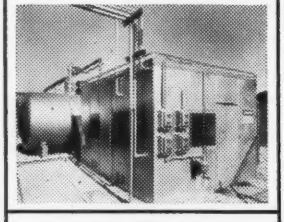


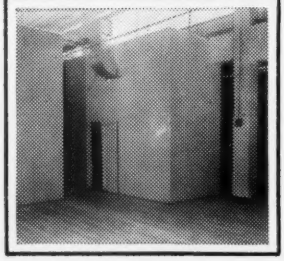


LS SAVES ON—

- √ DESIGNING
- √ TOOLING
- √ PROCUREMENT
- √ FABRICATION
- √ INVENTORY
- √ WAREHOUSING
- √ MAN POWER

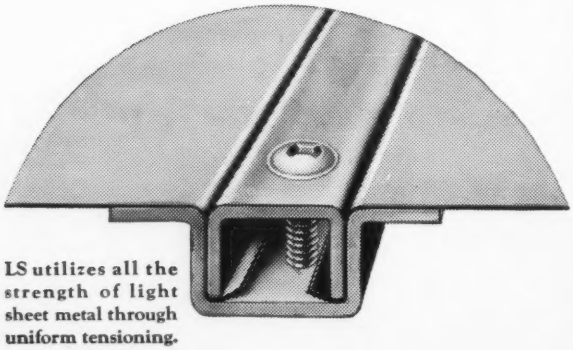






Lindsay prefabricated assemblies are *tailored to your exact needs* from die-formed, standardized, Lindsay Structure components . . . fabricated in 78,085 panel sizes . . . available in mild steel, stainless steel, copper, or aluminum . . . shipped k/d for quick assembly with standard tools. LS shipments can be scheduled to keep pace with your production needs. Fast service on pilot units.

Put this versatile, prefabricated structure to work for you . . . simplify designing, save on dies and tooling, conserve skilled man power. Write for descriptive folder or send single-line drawing for prompt cost estimate.



LS utilizes all the strength of light sheet metal through uniform tensioning.

LINDSAY-WILSON LIMITED
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Toronto 14

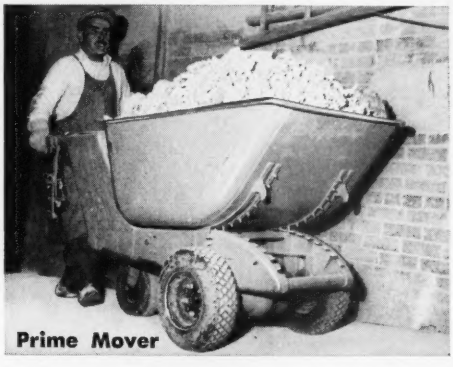
LS

On materials handling machines used by

Hyster

Baker-Raulang

modern farmers ... by the armed forces ...


Prime Mover

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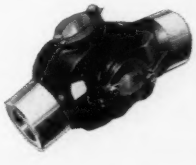
and by all branches of industry ...

Towmotor

BLOOD BROTHERS UNIVERSAL JOINTS
are first choice!

On all kinds of materials handling equipment, dependable Blood Brothers Universals have won "first choice" reputations. This success results in part from close cooperation between our engineers and the men who design the machines . . . with the mutual goal of superior performance for the end user.

When you have a power transmission problem—large or small—contact Blood Brothers' engineers for suggestions. They'll gladly work with you . . . just write or call.



BLOOD BROTHERS MACHINE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

HALF A MILLION

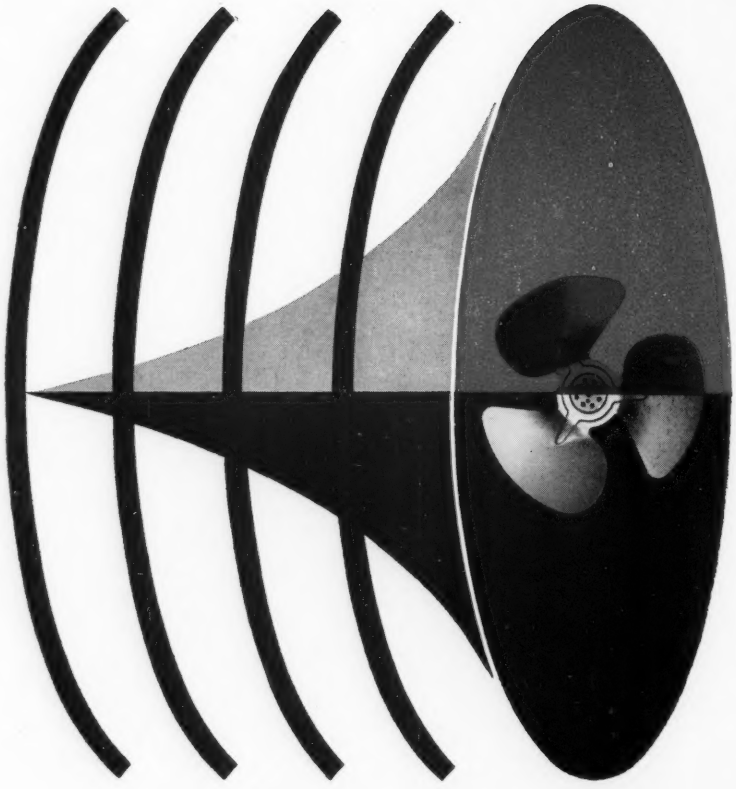
'VARIATIONS ON A THEME'

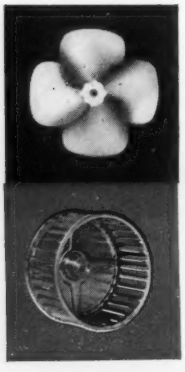
Industry writes the score—to the tune of nearly four billion dollars worth of products a year using Torrington air-impellers.

The research and development necessary to meet this tremendous demand is responsible for upward of half a million design variations of Torrington products... nice music when you have a tough problem.

If you are a design or production engineer, our exclusive engineering laboratory facilities—and our product engineering experience—are directly available to you for the solution of air moving problems related to your products.

Simply write or call us, or your nearest Torrington representative.





THE
TORRINGTON
MANUFACTURING COMPANY
OF CANADA LIMITED
OAKVILLE, ONTARIO
TORRINGTON, CONNECTICUT · VAN NUYS CALIFORNIA

People

Important people who are in the news

Recently elected President of the Canadian Manufacturers' Association, **J. N. T. Bulman** was born in Winnipeg on Christmas Day, 1900. He attended public and high schools in that city and then the Royal Military College in Kingston, Ontario, where he graduated.

Today, he is President and General Manager of Bulman Bros. Limited, lithographers and printers of Winnipeg and Vancouver. He is also a director of Central Northern Airways Limited, Winnipeg.

For over 20 years he has been an active worker for the CMA, serving on the executive committee of the Manitoba Branch and the Prairie Division, as chairman of the Manitoba branch in 1939-40, as chairman of the Prairie Division 1943-44, and as a member of the executive council.

• • •

Medal award winner

A consulting engineer in Ottawa, **Major-General Howard Kennedy, C.B.E., M.C., M.E.I.C.,** has been awarded a Julian G. Smith medal by the Engineering Institute of Canada "for achievement in the development of Canada."

This—the highest award conferred by the Institute—was not presented to the General for any one specific deed, but for a lifetime of service.

Born in Dunrobin, Ont., he received his B.Sc. in civil engineering from McGill University in 1914 and straight away began his military career. In the Canadian Engineers overseas he served with such distinction that in 1917, a Captain, he was awarded the Military Cross.

Back from the war, he was employed as resident engineer on building construction and as contractor on the building of roads and bridges. When, in 1922, he joined E. B. Eddy Co. Ltd. in Hull, Que., as an assistant engineer, he started his association with the pulp and paper industry — and in this phase of his activities too he rose to become one of Canada's most valuable experts.

For two years before the outbreak of World War II he had served as manager of Quebec Forest Industries Association. The war sent him overseas again where he rose from the rank of major in command of Third Field Company of the Royal Canadian Engineers to officer commanding the First Division of Royal Canadian Engineers.

Sent back to Canada in 1941 he rose in rank with each new task. Re-organizing and then working on trades training schedules and officer selection methods, he eventually became major-general and quartermaster-general of the Canadian Army.

In the 1944 New Year's List the General received the C.B.E. Since then he has been chosen honorary colonel of the Fourth District Royal Canadian Engineers and the Tenth Field Engineer Regiment.

The pulp and paper industry claimed him again after the war, first as vice-president in charge of woods for Ontario Paper Co. Ltd., and then as head of a Provincial Royal Commission to report on conditions and needs of Ontario forests. When the report was completed he set up private practice as a consulting engineer.

General Kennedy has served actively with many associations and societies. He joined the Engineering Institute as an Associate Member in 1921, became a Member in 1928 and attained Life Membership this year.

• • •

New president for EIC

A fine example of a non-rolling stone gathering moss is **Vernon Archibald McKillop.** Latest honor awarded to him — president of The Engineering Institute of Canada for 1956.

He is now general manager of the London (Ontario) Public Utilities Commission and of the London Railway Commission. He joined them immediately after graduation from the University of Toronto in 1924 and has since had no other employer.

Born in West Lorne, Ont., on March 12, 1899, he was educated at local schools before entering the university. The Army Service Corps interrupted his studies, but he returned to the university to continue the course in electrical engineering, and left with the degree of B.A.Sc.

His rise from assistant engineer to general manager of the Commission was made in regular stages. Vernon McKillop is now responsible for the distribution of electricity to the 100,000 people of London, for their supply of water and for the search for new underground supplies, for the smooth operation of the parks system and recreation program as well as for the management of the century-old city-owned railway which runs from London to Port Stanley.

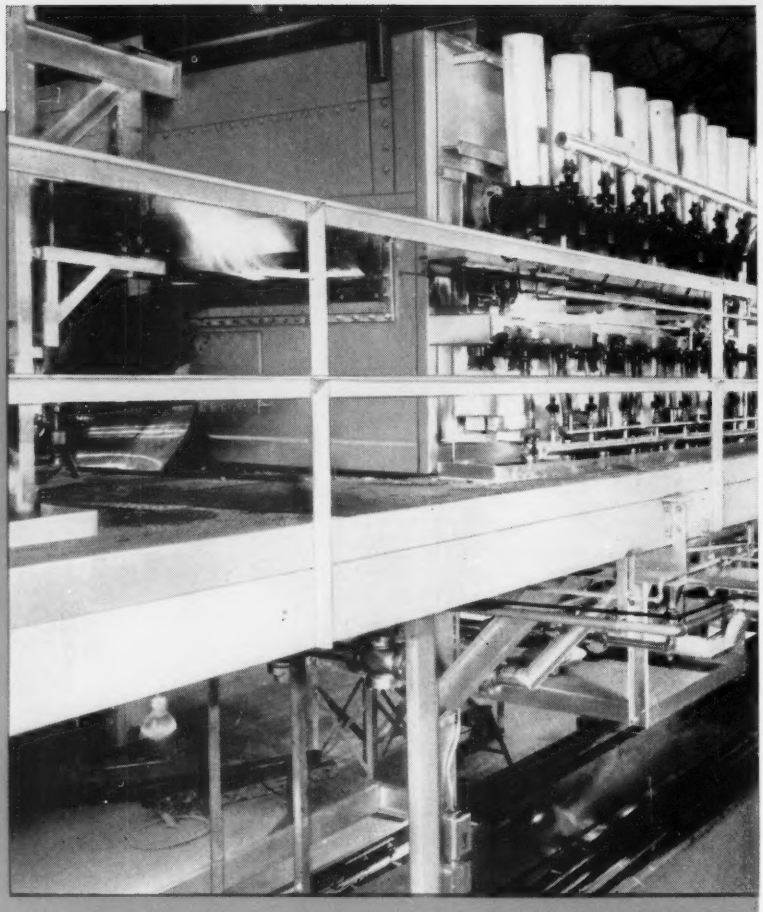
The Institute has had Mr. McKillop with them for almost as long as the Commission. In 1926 he was admitted as a junior member, became an associate member in 1929 and a member in 1940. With full membership came added responsibilities. From 1940 to 1955 he represented the London Branch on the council and was a trustee of the Bennett Educational Fund from 1948 to 1956.

At the London Branch of the Institute, where he has always been active, Vernon McKillop was appointed chairman in 1933. During the last war, and for some time after, he served as advisor to the London Board of Education. Here he helped civilians and veterans who were interested in an engineering career.

Other fields where Mr. McKillop is active include membership of the Association of Professional Engineers of Ontario, The Canadian Section of the American Waterworks Association — he is chairman this year — the Kiwanis Club of London (president in 1953), and the Association of Municipal Utilities (president in 1942).

Engineers Kennedy and McKillop at the recent EIC meeting in Montreal.

Normalizing and Aluminizing Steel Strip



Furnaces for a process of continuous annealing and aluminum coating of wire are manufactured by Canefco Limited.

Canefco builds continuous aluminizing lines. This equipment incorporates a direct fired preheat section, a radiant tube heated reducing section, a combination air cooled and electric heated section, a fast indirect cooling section, a resistance heated aluminum pot to produce a tightly bonded aluminum coating.

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Design Engineering

New method for precision of cast parts

One-piece glass powder molds can now be used for low-cost metal casting by the Glascast disposable pattern process.

Use of one-piece glass powder molds for low-cost precision metal casting was recently announced by Corning Glass Works.

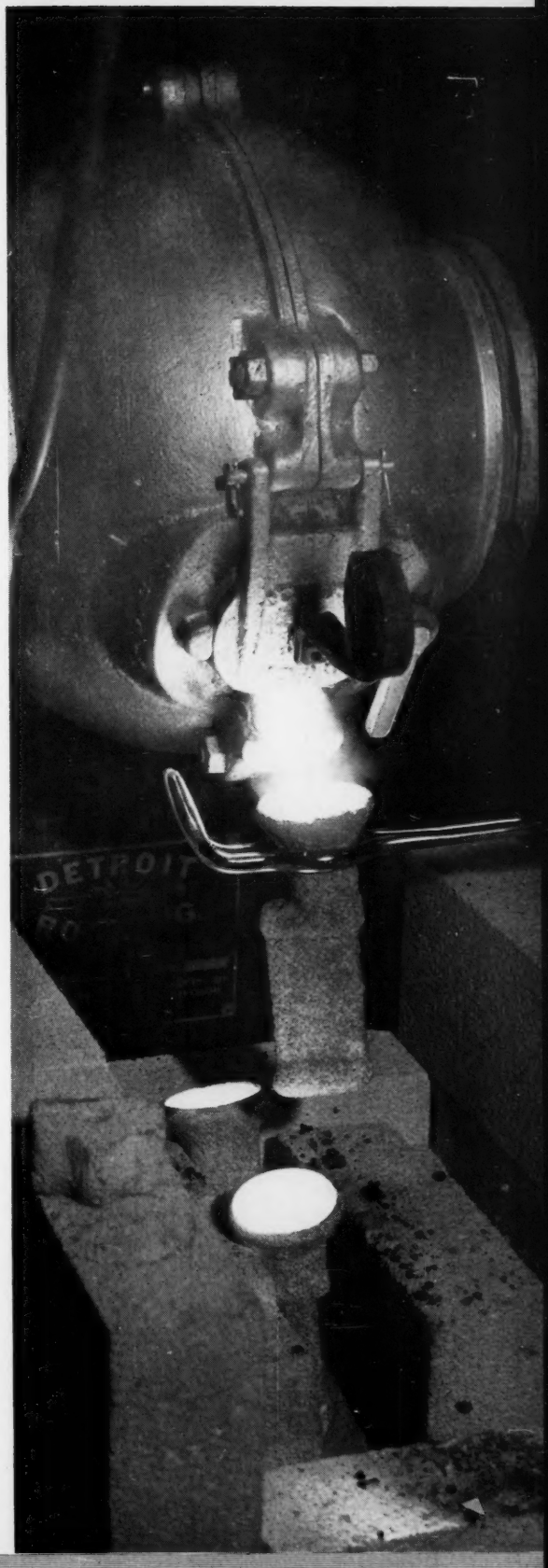
Known as the Glascast disposable pattern process, the new method is like the lost wax investment casting technique in certain respects, except that it does not need investment material or containers, dewaxing ovens, power equipment (to move investments) or knockout equipment.

The lightweight molds are made by dipping a wax pattern into a slurry, coating it with coarser grains and, after drying the assembly, dipping and coating it several times to build up the mold shell.

The assembly is then fired (the wax pattern is removed at the same time) and the mold is ready for casting without further treatment.

The process was developed for casting close-tolerance precision parts of high temperature alloys. The one-piece molds, capable of withstanding extremely high heats and sudden temperature changes, yield blemish-free castings with surface finishes of 20 to 40 micro-inches.

Tight dimensional control of fine definition castings is assured by the extremly low thermal expansion of the mold material, a 96% silica glass powder. Low dimensional change, and the absence of firing shrinkage in the molds, enable an accurate calculation of metal expansion to be made. The molds can stand temperature of 3,300F and tolerances of ± 0.005 per in.



Monolithic molds stand up to pouring temperature of 3,300 F, need no backing during pouring.

The thin Glascast mold shell (⅛ to ¼ in. thick) assures extremely rapid cooling to control grain sizing. Metal contraction after casting causes the non-contracting mold to crack off, freeing the casting of adhering ceramic material and eliminating knockout equipment and time.

The Glascast mold has excellent resistance to thermal shock. Metal alloys with high melting points may be poured into a cold mold without fear of its cracking. Preheating is recommended, however. The coefficient of expansion for the material is 47 x 10^{-8} in. per in. per deg F between 0 and 587F.

The fine powder (-325 mesh) has excellent chemical stability and so prevents surface imperfections caused by mold reactions with metal or metal oxides. The initial dip coating of Glascast, a substantially different material from the normal investment, eliminates mold cracking and surface spalling. In test production runs of jet engine turbine blades, less than 10% of the castings have been rejected for surface pitting or other imperfections.

The entire process (according to Corning), is adaptable to assembly line practice. Pattern-to-casting time is cut drastically with an average of 24 hours between wax pattern make-up and casting.

Basic equipment needs for this disposable pattern process are simple: mixing containers, high speed propeller mixers, rollers, stoppered bottles, dipping troughs, grain coating boxes and a furnace capable of 2,000F temperatures.

Regular lost wax pattern dies are used for the patterns.

The slurry is prepared by mixing the powder in water, stirring carefully and putting it into bottles. Binding and adhesive agents are added to the slurry and the bottles stoppered and set on rollers for a mixing period of 8 to 12 hours. The viscosity of the slurry, using a Zahn No. 4 viscosimeter, should be 29 seconds.

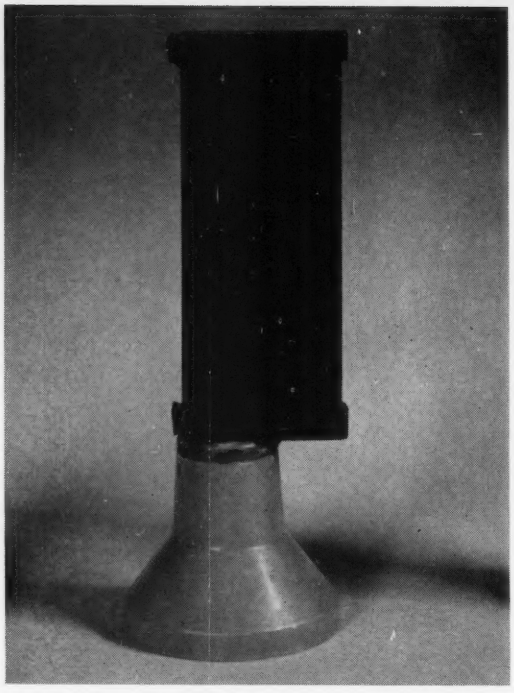
The first dip of the wax pattern into the slurry is dried by ammonia for three minutes and then dipped again. While still set, it is coated with Glascast grains and dried again. The dipping, grain coating and drying cycle is repeated five or six times, depending on the slurry viscosity.

Since wax expands under heat quicker than Glascast, it is important not to raise the air temperature during drying.

After the final dip and coating, the assembly is dried for several hours at normal room temperature (when drying agents have been added) and is ready to be fired. Without drying agents the assembly will dry in eight hours. Negligible drying shrinkage of the mold gives extremely low drying losses.

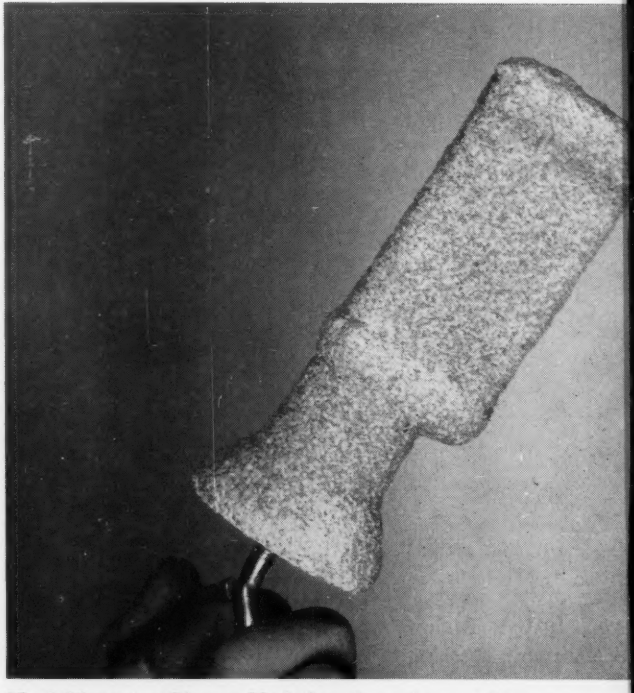
There are two methods of removing the wax from the assembly (as in the lost wax process)—degreasing to dissolve the wax or burning out the wax in a furnace. However, a special dewaxing-firing furnace developed by Corning is strongly recommended.

This is a standard top loading type with a removable bottom, capable of temperatures up to 2,200F. When the furnace temperature has reached 1,920F, the inverted mold is inserted and the bottom of the furnace pulled out. The low thermal expansion of Glascast makes flash firing at extremely high temperatures possible. The wax, hit suddenly by this high temperature, melts from the mold without expanding or burning and falls through the furnace to a container below. The furnace bottom is replaced and the mold fired. For single blade molds entire dewaxing and firing cycle takes 10 to 15 minutes. Larger assemblies take longer. ★

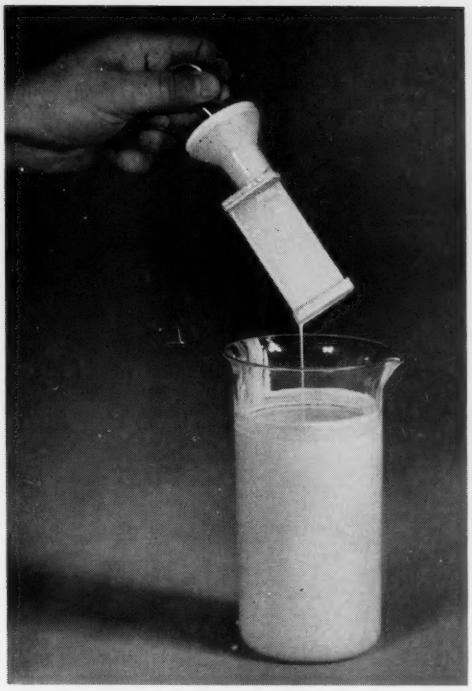


The model wax pattern used in the Glascast disposable pattern process has an extremely thin trailing edge.

Process lends itself to assembly line



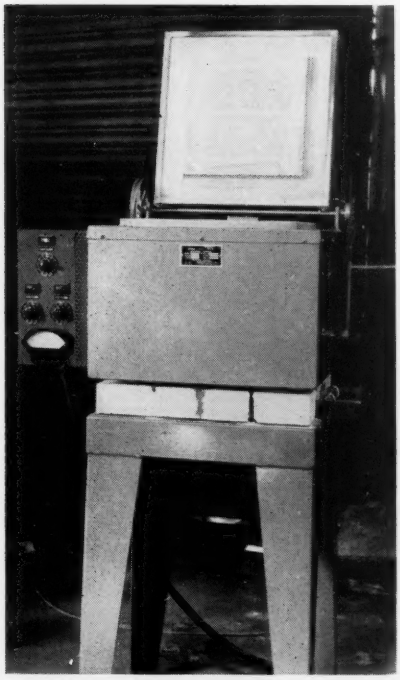
Final Glascast mold assembly before de-waxing and firing. The wax surface finish is then reproduced exactly thereby.



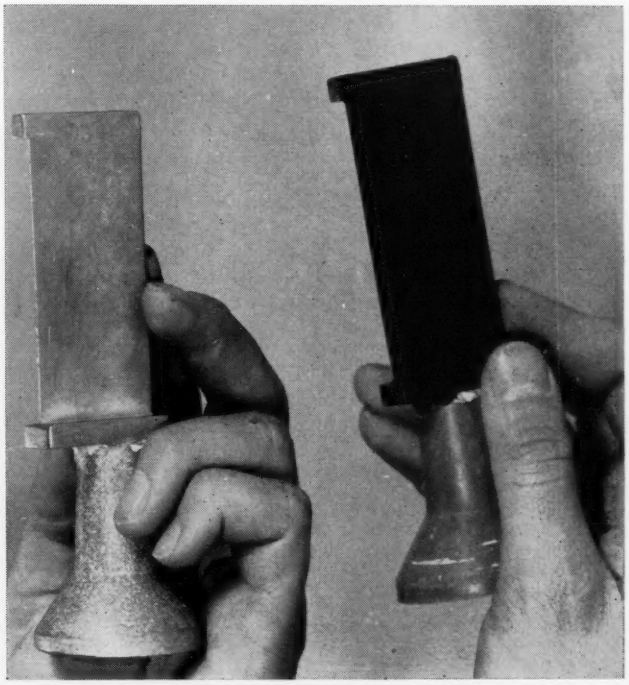
The first step in the process is the dipping of the wax pattern in a slurry.

Before the slurry has dried on the wax pattern, the assembly is coated with coarse grains, dried at room temperature, dipped and coated.

practice and pattern-to-casting time is drastically cut to 24 hours average.



Modified top-loading furnace with removable bottom to allow wax to fall down.



Comparison of a metal casting made by the Glascast disposable pattern process (on the left) and of wax pattern used in process.

Check periodic motion stroboscopically

By presenting to the eye of the observer a series of accurately - timed images, electronic stroboscopes can measure speed and study motion.

By S. A. Rybb DAWE INSTRUMENTS LTD.

During the last decade, many applications have been found in industry for the electronic stroboscope. It provides means for measuring speeds and for studying periodic motion (rotational and reciprocating) by representing to the eye of the observer a series of accurately-timed images of the object.

In principle, the electronic stroboscope is a source of light flashes, in which the flashing rate and flash duration can be controlled with great accuracy and stability.

Due to the effect known as persistence of vision, the retina of the human eye is capable of retaining the image for a fleeting instant longer after the stimulus has been removed. Thus, if a series of identical images are presented in a short period of time, the eye will provide a continuous record to the observer, if the interval between the images is short enough. This record appears as a blur, and in this way a rapidly revolving fan will appear as a dim perception, the individual blades being indistinguishable.

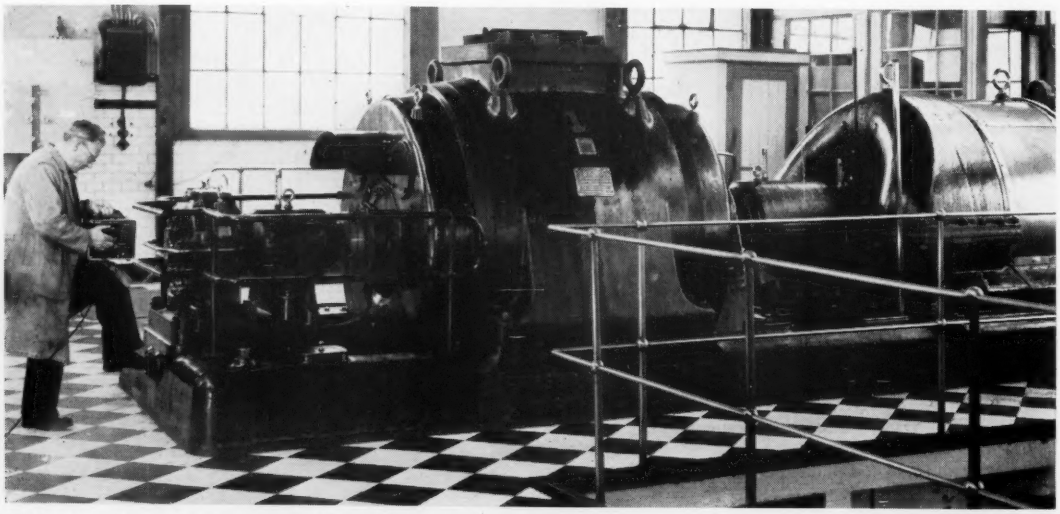
When the flashing light is focused on the moving object and its rate of flashing is synchronized with the motion, the object will appear to the eye as though it is standing still.

The explanation of this phenomenon is relatively simple. If we consider a single hand of the clock rotating in front of its dial at high speed, the resulting motion, when viewed without a stroboscope, appears as a blurred disc. If the light flash of the stroboscopic lamp is made to occur when the hand is exactly at 12 o'clock, then for the duration of the flash, the eye will receive an image of the hand in this position. If the rate of flashing is such that the next flash occurs exactly one revolution later, the hand will again be at 12 o'clock and the eye will receive another image in this position. Repetition of flashes at this rate will, therefore, produce on the retina of the eye a series of images of the hand at 12 o'clock and due to the persistence of vision the hand will appear to be stationary in this position.

A similar result is obtained when the lamp is made to flash every second, third or fourth revolution of the hand, since superimposed images are still obtained.

If the flashing rate of the stroboscope is increased to twice the rate of revolution of the hand, the hand will be illuminated twice per revolution and two images, displaced 180 deg. with respect to each other, will appear. Similarly, a flashing rate of three or four times the speed of the hand will produce respectively three images spaced 120 deg. apart or four images spaced 90 deg. apart.

The adjustment of the flashes with respect to the hand rotation will result in the stationary image of the



Without making actual contact, a check is being made on speed of turbo-alternator by means of electronic stroboscope

hand appearing, not only in the 12 o'clock position, but in any position around the dial, so that the examination of the mechanism at any point in its cycle of operation is possible.

If the flash rate is slightly lower than that of the mechanism, then each succeeding flash will occur at a slightly later point in the operating cycle and the mechanism will appear to an observer to be working in a forward direction at a speed equivalent to the difference between that of the mechanism and that of the stroboscope. With a higher stroboscope speed, this difference will be negative and the mechanism will appear to go in reverse.

One of the main applications of the stroboscope is for speed measurement. This is particularly true in cases where a mechanical tachometer cannot be used, as in motors where the end of the shaft is not accessible or fractional HP motors. In the case of the latter, where "no load" speed has to be measured, a mechanical tachometer attached to the end of the shaft applies a load and thus gives a false indication. With the stroboscope, no contact with the rotating object is made, and the true "no load" speed can be determined.

A further general application is for inspecting machinery while it is actually in motion. This permits the detection of any signs of maladjustment, distortion, vibration due to unbalance and discovery of transient phenomena and stresses which occur at high speeds.

In this way, stroboscopes prove to be very valuable in general industrial maintenance work where they are extensively used for checking the operation of cutting tools, drills, saws, cams, gears, commutators and many other rotating parts.

The motor car and aircraft industries find the stroboscope very useful in their production and development work. The action of the various reciprocating parts of an engine can be illuminated and studied under stroboscopic light. These include studies of valve action and of valve springs under stress, the operation of camshafts, the effect of flywheel mass on speed variations, studies of piston and piston ring action and so forth.

In the radio industry, stroboscopes find application in the design of loudspeakers, vibrators and the like. In the case of vibrators, the frequency and amplitude can be measured and suitable adjustments for optimum conditions of operation made, whilst for loudspeakers, the movement of the cone and spider can be studied. The circumference of a cone tends to vibrate at certain resonant frequencies with a consequent sound distortion. This effect cannot be altogether eliminated but it can be reduced by clamping down the edges. When studying the effects of different frequencies on the loudspeaker cone motion, the edges are not clamped but are allowed to vibrate freely with the cone. A known frequency of relatively high amplitude is fed into the loudspeaker and the cone viewed under the stroboscopic lamp. The periphery of the cone can be seen to be divided into a number of equal sections, each vibrating with a fixed node between two adjacent sections. When the applied frequency is increased, the nodes remain stationary but the rate of vibration of the standing wave in the sections between the nodes increases with the consequent fall-off in the amplitude. At certain critical frequencies, a sudden change takes place to a higher mode of vibration with a greater number of nodes.

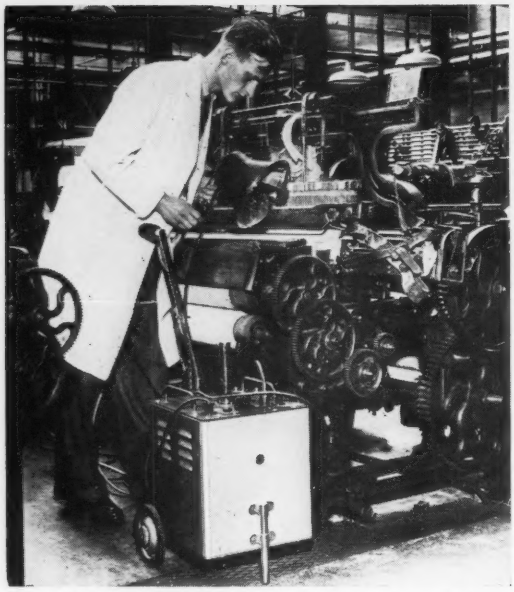
Other stroboscope types

Another interesting application of the stroboscopic principle is in the printing industry, where it can be used for checking registration. In continuous processes, such as web-fed rotary printing with re-reeling, the examination of the quality of print is not easy, since there is no point at which the operator can effectively check the work during the normal run, until the entire reel has been printed. A skilled operator can check the intricate printing design by following the pattern as it runs through the press at speeds up to about 200 fpm. Modern printing machines, however, can operate at speeds considerably in excess of 200 fpm, provided suitable means of inspection are used. The stroboscope provides this opportunity by "freezing" the motion of the paper, thus making it possible to examine the pattern for its printing quality. Apart from registration, stroboscopes have wide application in the printing field in checking the assembly of printing machines and equipment.

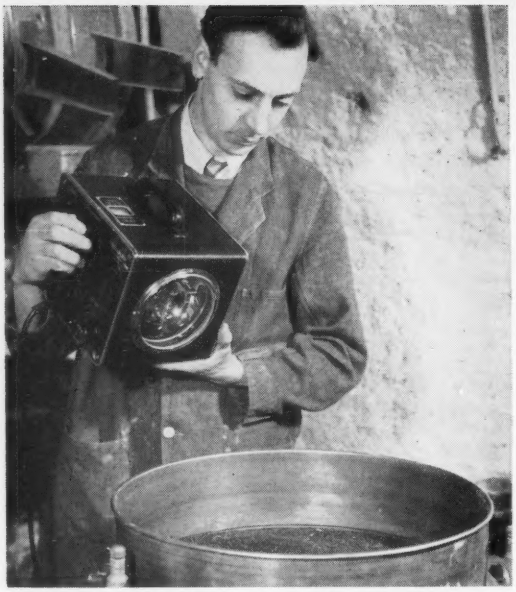
One of the most interesting developments of the stroboscopic principle as applied to printing has recently been introduced to flexographic printing. In this pro-

This, the most common type of stroboscope, has a range of 250 to 18,000 flashes per min.

To overcome the lack of persistence of vision at low flash intensities, the flash tube of the instrument shown above is a xenon-filled lamp.



Inspecting the operation of the shuttle on a textile loom by means of an electronic stroboscope, the stroboloom.



Typical application for the Type 1200 stroboflash. Here operator is checking the action of a vibration shaker.

Electronic stroboscopes are particularly useful when a mechanical tachom-

cess, type is made of plastic or rubber instead of metal, and a very free-flowing ink is used. The essential feature of this type of printing is the contact between the type roller and the paper, the setting of which is very critical. Too high a pressure tends to distort the type, whilst a slight under-pressure will give no impression at all. Without the use of a stroboscope, trial runs have to be taken, with consequent adjustments between the tests, until the correct setting is achieved. With the stroboscope providing a ready image of actual printing, the adjustment can be carried out whilst in motion.

In the textile industry, the stroboscope has found application in studying the motion of the loom shuttle. The shuttle can be viewed, apparently stationary, at any desired position of the weft, and its speed determined.

To meet the requirements of such a diversified field of applications, an entire range of electronic stroboscopes has been developed. The most common type of stroboscope (illustrated) consists of a resistance-tuned tube oscillator, provided with a variable frequency or speed control having a calibrated dial graduated in

Use this instrument for applications where a very high light intensity is required. Its light output is about 200 times that of stroboflash.

The stroboloom is a specialized instrument developed for use in the textile industry.

Checking a commutator for wear by "freezing" it with a stroboflash, just one more application for this instrument.

The versatility of the stroboflash is well shown by this further application; checking the slip of automobile fan.

eter cannot be used; for inspecting machinery; in designing loudspeakers.

flashes per minute. This oscillator is used to drive the neon flash tube mounted within a parobolic reflector, which flashes at the frequency of the oscillator. The frequency range of the oscillator is from 250 to 18,000 flashes per minute, which makes possible direct speed measurements within those limits. Speeds outside the scale range of the instrument can be measured by using multiples of the flashing speed. Thus, with the instrument set to, say, 18,000 rpm a double image will appear at a speed of 36,000 and treble and quadruple images at speeds of 54,000 and 72,000 rpm respectively. The speed calibration of the instrument can easily be checked and adjusted, if necessary, by means of a vibrating reed, provided the line frequency is known.

Provision is made also for the use of an external lamp unit of the pistol-grip type. This is valuable when observations are to be made in locations and positions not easily accessible to the stroboflash.

By employing a contactor unit, the flash rate of the instrument can be locked to any rotary mechanism.

The use of this device eliminates the "shift" effect caused by small speed variations when the stroboflash is operated from the internal oscillator, or by small speed variations of the object under observation, and is particularly recommended for applications where a perfectly stationary image is essential. It consists of an aluminum casting in which is housed a freely rotating shaft mounted on a double ball bearing. The shaft is fitted with a commutator having a single insert segment. This makes contact with a silver-plated spring mounted in a housing which can be rotated to make the contact point occur at any desired position in the revolution.

The neon flash tube used in the stroboflash emits an orange light which is not very intense, making speed measurements below 600 rpm rather difficult, due to the lack of persistence of vision at low flash intensities. To remedy this, the instrument commercially named Strobotorch has been developed. As in the case of stroboflash, it employs a resistance-tuned tube oscillator with a variable speed control, but its flash tube is a xenon-filled lamp emitting a white light of very high intensity. To achieve the triggering action, the output of the oscillator is applied first to a low intensity trigger tube. The short duration pulses thus appearing in the plate of this tube are applied to the primary of a high ratio step-up transformer. The ionizing or triggering pulse of the high intensity flash tube is obtained from the secondary of this transformer. A condenser, charged to a high voltage, is connected directly across the flash tube, in which the gas pressure is such that the high voltage does not produce a spontaneous discharge.

Obviously, to accommodate the high voltage power supply, together with oscillator and flash tube in one cabinet, would make the instrument much too heavy and bulky for easy handling. Consequently, the instrument is built in two units, one containing the power supply, oscillator and triggering circuit and a second unit, connected to the first by a cable, consisting of the lamp unit and calibrated speed control. This arrangement is particularly convenient for prolonged operation or use in awkward positions, as the lamp unit is light and small and the difficulty of adjusting the flashing rate from a separate unit is avoided.

The fundamental calibrated flash rate of this instrument is 120 to 14,000 flashes per minute and it is valuable for work at low speeds or at high speeds, when the background illumination is very strong.

For applications where very high light intensity is required, the instrument called Stroboflood can be used. It also uses a xenon-filled tube, the light output of which is approximately 200 times greater than that of

(Continued on page 72)

Here's how you can design safety valves

Until now, manufacturers of safety valves have kept their design methods a close secret. This article reveals these methods for the first time

By James D. Orr ORR ASSOCIATES

Strangely enough, very little has been published on the design and functioning of safety valves. The writer has been fortunate in being given the opportunity to carry out a research program in this field, in conjunction with the James Morrison Brass Manufacturing Co. Ltd., thus gaining somewhat unusual experience as a Canadian engineer. Perhaps some of the fundamentals involved will be of use to other engineers interested in such devices. Perhaps too, they will break the secrecy barrier evident in industry.

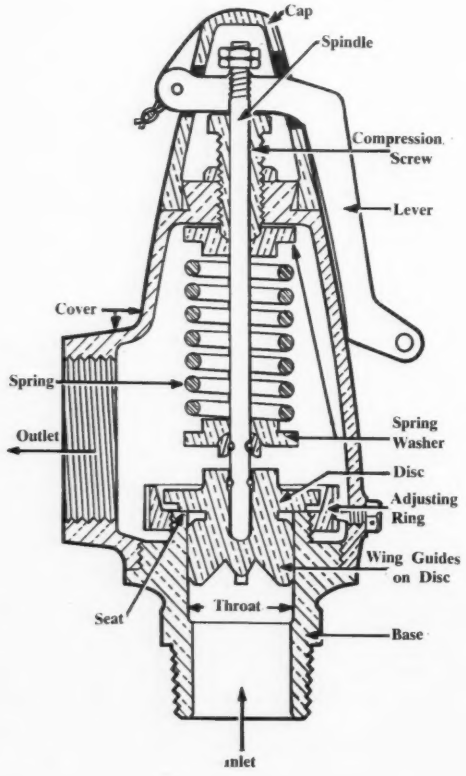


Figure 1. A cross-section of a well laid out safety valve showing the components involved in the design.

A safety valve is not merely a plug over a hole held down by a spring, as I used to think of it. It is, in fact, a very complex and sensitive device in which thermodynamic theory is subtly woven. A safety valve is mounted on a pressure vessel and, as the name implies, acts as a relieving device when the vessel pressure exceeds its safe working value.

There are many different types: these vary in design according to the pressure, temperature, capacity required and substance to be relieved.

Bronze pop safety valves

Bronze pop steam safety valves have been chosen as the present subject: these will be described from the standpoint of their geometry as it relates to function. Left out therefore, will be such things as metallurgical considerations, erosion prevention, temperature distortion, spring design (very important), stress analysis and design, production tolerances and so on.

High capacity is one of the main essentials in good valve design since it reduces the number (or size) of valves required and also the cost per thousand pounds of steam relieved. Spring size is also reduced.

Essentially then, a good safety valve acts as follows: When the set pressure in the vessel is reached, the valve pops open cleanly with little or no warning. The lift is as great as possible at the accumulative pressure for maximum capacity and the valve closes again within the required blowdown, in order that costly steam is not wasted after the danger of over-pressure has passed.

The maximum capacity of a valve would be obtained if it were a perfect nozzle ($C_a = 1$) and lift was equal or greater than one-fourth the throat diameter. The area of throat $= \pi D^2/4$, where D is the seat diameter. Annular area between disc and seat = Lift x π x D, so that if the lift equals D/4, the two are equal.

In the type of valve under discussion, the disc is guided by its wing guides which fit down in the valve throat. These restrict the lift and reduce the C_a. Because of this restriction in lifting effort, a lift of D/4 is not attained in this type of valve.

Maximum lift, however, is desirable and a means for

obtaining it is an improved valve design would involve knowing how the lifting effort was produced by the steam on the disc. If lift is plotted against load (Fig. 2), the relationship between the lifting effort (load) and the lift could be analyzed and the design factors in the valve influencing this relationship, as well as blowdown and C_d could be isolated.

An instrument was designed, as shown schematically in Fig. 3. Several types of safety valve were then tested using this instrument and all gave load-lift curves of about the same shape as in Fig. 2. The pressure was kept constant and the lift was made to vary in increments of 0.010 in. from closing, up to maximum lift and back down again (the spring was removed from the valve being tested).

The shape of the load lift curve was seen to be independent of the pressure and showed that valves of this type could not be made to reach D/4 within the accumulated pressure.

The load-lift curve shown in Fig. 2 shows how an actual valve functions. The spring having a constant rate (lb. per in. deflection) shows as a straight line, the slope depending on the rate. At popping, the valve spring being pre-compressed exerts a load "a" on the disc. Since the steam exerts an upward force of the same magnitude, the two forces are in equilibrium and the disc will remain closed. A very slight increase in pressure destroys that balance of forces, the valve opens and since the steam force upward increases at a greater rate than the spring force downward, the disc will keep lifting. From Fig. 2, it can be seen that the spring load curve is a straight line and the steam load increases at a decreasing rate. Thus, these two lines cross at lift "b", equilibrium has been re-established so that, if the pressure remains constant, the disc will stay in the same position (called popping lift). If, however, the pressure increases say 3% (to accumulated pressure), the steam load increases and the disc will rise to position "c".

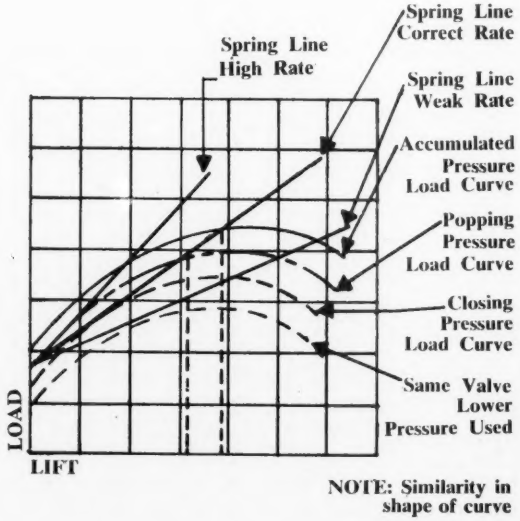


Figure 2. An analysis of the load-lift relationship.

Requirements for satisfactory design of bronze Pop Safety Valves

Certain terms are used when we talk about safety valves and the ASME Power Boiler Code stipulates how these terms are to be defined. Their definition therefore results in fast rules for the way in which a safety valve must act. The following terms are often heard (see Fig. 1).

Set pressure or pop point

The gauge pressure at which the valve is set to open for pop.

Capacity lift

The distance in inches the valve disc raises above its seat when the valve is blowing at accumulated pressure that is, 3% above set pressure.

Rated capacity

90% of the number of pounds of steam per hour the valve will pass when relieving at accumulated pressure.

Blowdown or loss

The difference in pounds of steam pressure between the opening and closing pressure. Regulated by the Code to 4% of set pressure. For example, a valve set at 100 psig would have an accumulated pressure of 103 psig and a closing pressure of 96 psig with a 4 psig blowdown.

Coefficient of discharge (C_d)

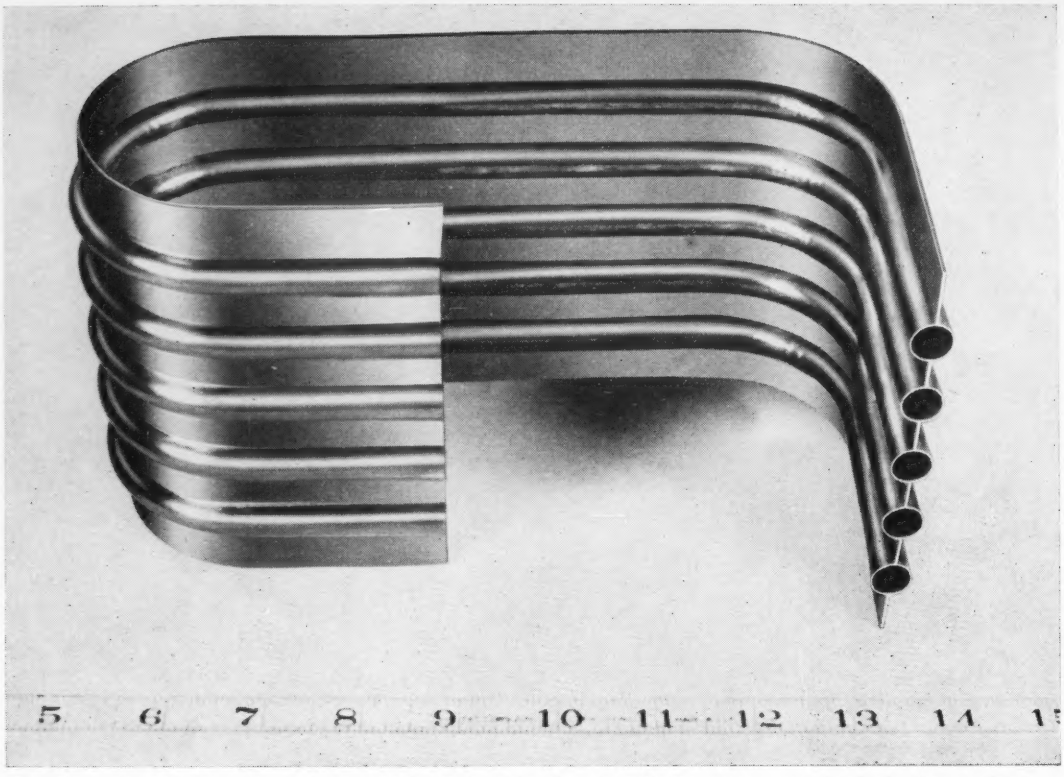
The ratio of the actual measured steam flow to the theoretical steam flow as computed by Napier's formula and the area of opening through the valve at capacity lift. This is of course, always less than unity. This value for C_d must not vary more than $\pm$ 10% over the complete range of sizes and pressures for a particular design of valve.

Simmer or warn

The valve is simmering or warning when it allows a relatively small flow of steam to escape just as set pressure is reached. This is undesirable, since it results in a wire-drawing condition where the seat is eroded by the high velocity of steam. The valve should reach set pressure and pop clean to full flow without simmering. This can occur even in a new valve if it is not designed properly.

Chatter

The valve is chattering when the disc vibrates up and down rapidly against the spring pressure while the valve is blowing, unable to reach a stable lift position. This is very harmful to any valve and although it could be caused by a fluctuating steam supply, more often it results from incorrect design of the valve or spring.



Part shown here has been formed on multiple die hand bends after inflation using normal tube-bending techniques.

Heat exchangers can use this product

Tubes inflated to any running length in this strip or sheet mill product

This product is made by incorporating strips of chemically inert friable material into the casting before rolling. Sold in its flat form, the sheet or strip is then stamped, bent or drawn to shape before the tubes are inflated by air pressure or hydraulic means, depending on the thickness of the tube walls. It is also possible to inflate the tubes first and use normal tube bending methods for the final forming.

The manufacturers, Revere Copper and Brass Incorporated, go to great lengths to point out that, except for the expandable portions, this is a solid strip of metal and not two pieces of metal brazed, welded and rolled together.

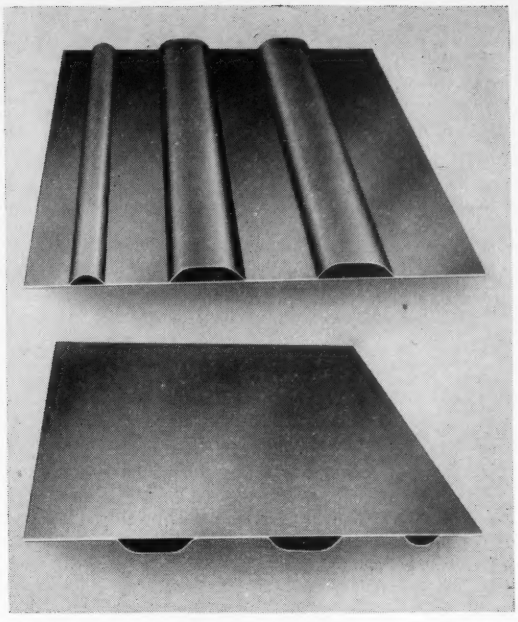
By allowing free expansion, the tubes become round; by holding the metal in restraint it is possible to keep one side flat; by using dies many tube shapes can be realized.

Tube spacing can in most cases be as close as ¼ in. and inside diameters can be carried within a single sheet of metal from 3/16 in. to 1 in. Tube wall gauges can vary from 0.0025 in. to whatever the inflating equipment permits. At present, this strip can be made of aluminum in widths up to 34 in. and of brass and copper up to 16 in. Soon brass and copper strips should be coming from the mills in widths up to as much as 24 in. or more.

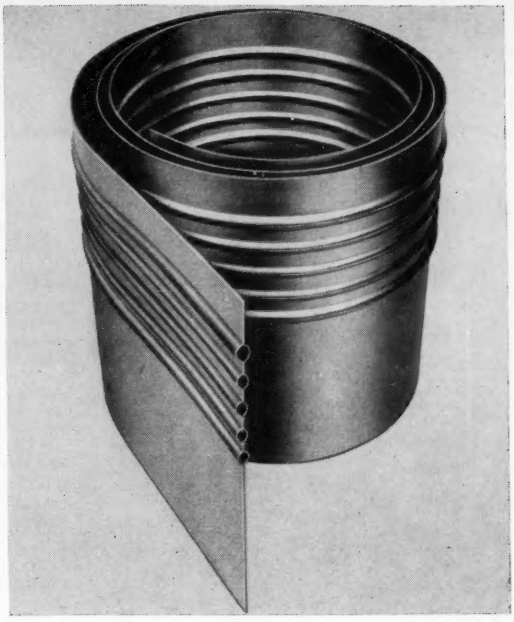
In its heat exchange roles it is likely that this product will be used extensively in refrigeration, air conditioning, chemical and process industries, for house heating, food processing and so on. Because of its interesting structural possibilities, it might also find acceptance in the aircraft industry and in architecture, as well as in many other fields, where it can be used solely as a structural member or a structural member with built-in conduit for wires or the passage of fluids.

Comparing the thermal performance of Tube-In-Strip with bare tube it should be noted that the strip advantage is determined by the extra transfer surface—the web—and so is greatest when resistance to heat transfer is largely on the outside of the tube.

A number of interesting methods have already been thought up for making various units and components. For return bends the web can be cut away and the bend fitted on the outside diameter, or the web can remain and the bend be fitted inside the tubes. Headers can be rolled from the ends of the strip itself; regulator sheet, folded accordion style to separate two strips, forms an automobile radiator with fin centre; an evaporator plate is simply a strip with the tubes on one side only. ★



Two views of section for use as an evaporator shell. Note that the part has been inflated on one side only.



The product can be inflated and used in the form of a coil of any length. Lower half of this coil is not inflated.

Except for expandable portions, is a solid strip of metal, not two parts

Present Commercial Limits of Manufacture of Tube-In-Strip

	Copper & Brass	Aluminum
Alloys	Deoxidized Copper 85-15 and 70-30 Brass Others later.	1100 and 3003 only.
Strip Widths	Up to 16 in. (up to 24 in. later).	Up to 30 in.
Minimum Gauges	Web thickness 0.006 in. Tube thickness 0.003 in.	Web thickness 0.020 in. Tube thickness 0.010 in.
Tube Size	3/16 in. to 1 in., in unexpanded condition.	3/16 in. to 1 in., in unexpanded condition.
Tube Spacing	Minimum 3/16 in. between adjacent tubes.	Minimum 3/8 in. between adjacent tubes.
Number of Tubes	Depends on strip width, but any number which is approximate sum of: (1) uninflated tube width: (2) spacing between tubes (web) and (3) ¼ in. minimum at each outer edge, if tubes are located at these outer edges.	Depends on strip width, but any number which is approximate sum of: (1) uninflated tube width (2) spacing between tubes (web) and (3) ¼ in. minimum at each outer edge if tubes are located at these outer edges.
Lengths	Coils or cut to length for these alloys, up to about 700 to 800 lb total weight per piece.	Coils or cut to length for above alloys up to about 1,000 lb total weight per piece.
Tolerances	Gauge, width and length in unexpanded condition are same as for regular copper and brass products.	Gauge, width and length in unexpanded condition are same as 1100 and 3003 coiled sheet.

Double life of printed circuit connectors

When spring-type connectors are used, beryllium copper contacts give better fatigue resistance, electrical characteristics, reliability, accuracy

There are two good reasons for selecting beryllium copper as a contact material in printed circuit connectors. A fatigue resistance two or three times that of other spring-type contact materials (such as spring brass or phosphor bronze) and excellent electrical characteristics.

Where connectors are used for insertion or removal of printed circuit cards, it is claimed that a beryllium copper alloy will give positive contact for 1,000 insertions or more. The connector is, of course, the vital link between cards, or between the power source and cards, so that the reliability and accuracy of the electronic equipment depends largely on the efficiency of this spring-type contact.

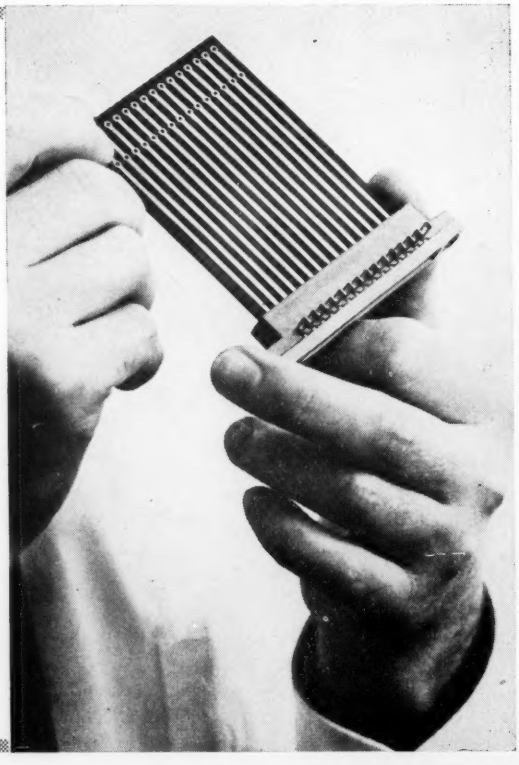
The average printed circuit connector is a long flat insulator, with multiple bifurcated contacts which engage both sides of the circuit board. Copper laminations, however, are printed on only one side of the card. The beryllium copper contact is in the form of a U-shaped strip which grips the printed circuit card.

A phenolic insulator base houses one or more of these contacts which are mated to the card by dip-soldering or by friction. Dip-soldering is recommended, because it permits the contact to absorb the punishment of connect-disconnect. Otherwise, the connector outwears the copper cladding, which tends to peel back or wear through. The contacts are generally formed by stamping, but sometimes by machining.

For the severe forming operation, heat-treatable Berylco 25 alloy strip, 0.015 or 0.022 in. thick was selected. This alloy, a product of The Beryllium Corporation, provides, after heat treatment, the strength and other final properties required. The finished heat-treated part has the high fatigue limit desired, together with excellent wear resistance and high conductivity (see Table).

The contact is held in the insulator by crimping, twisting or two piece captivation. Localized annealing, accomplished by both induction heating or the flame method, is used to soften the spot in the beryllium

Details of printed circuit contacts, connectors, cards



(Above) Fig. 1. Cross-section of connector showing contact encased in phenolic plastic insulator. (Right) Fig. 2. Typical printed circuit card is inserted in this receptacle-type Buggie connector.

Table — Properties of Berylco 25

Berylco 25 is a standard high-performance material of the beryllium copper alloy series, having a nominal chemical composition of Be 1.80 to 2.05%, Co 0.20% to 0.30%, Cu balance. The alloy has high strength, good electrical conductivity, long fatigue life and excellent wear resistance.

Berylco 25 strip is supplied in any of four heat treatable tempers:

Temper	Tensile Strength Ksi	% Elongation on 2 in. (minimum)	Rockwell Hardness		Electrical Conductivity % IACS (minimum)
			B Scale	30T Scale	
Solution Annealed (A)	60–78	35	45–78	45–67	17
¼ Hard (¼H)	75–88	10	68–90	62–75	16
½ Hard (½H)	85–100	5	88–96	74–79	15
Hard (H)	100–120	2	96–102	79–83	15

After heat treatment for the times indicated in the table below, resultant properties are:

Temper	Heat Treatment at 600 deg. F.	Tensile Strength Ksi (minimum)	% Elongation on 2 in. (minimum)	Rockwell Hardness		Electrical Conductivity % IACS (minimum)
				C Scale (minimum)	30N Scale (minimum)	
Solution Annealed (A)	3 hrs	165	5	36	56	22
¼ Hard (¼H)	2 hrs	175	3½	38	58	22
½ Hard (½H)	2 hrs	185	2	39	59	22
Hard (HT)	2 hrs	190	1	40	60	22

copper contact to be crimped. If the contact is connected with wires, these are attached by soldering or mechanical means.

Standard Buggie connectors employ a plating of gold over silver on the beryllium copper contacts to provide low resistance, even with light contact pressures. Other plating metals (rhodium is an example), are sometimes used where special electrical or corrosion-resistant characteristics, such as high frequency conductance and low contact resistance, are needed. Rhodium, for example, is used for an unusual combination of corrosion and wear resistance and hardness, as well as low and stable contact resistance. Whichever metal is used, plating baths do not cause hydrogen embrittlement in beryllium copper and affect its endurance.

The company's standard line of connectors for printed circuits includes three designs which employ beryllium copper contacts with a plating of gold over silver. One design (Fig. 2) is a card receptacle for up to 15 contacts with solder tabs permanently connected to a base board circuit. A variation of this employs terminal pins in place of the solder tabs, for attachment to the base board by hot dip soldering. The third type is a terminal connector strip which has a series of female mating sockets to receive terminal pins. Solder tabs are provided for permanent connection of the strip to a base board. Through custom designing, the firm has turned out between 50 and 75 modifications of these basic types.

Figures 3 and 4 show some different styles. ★

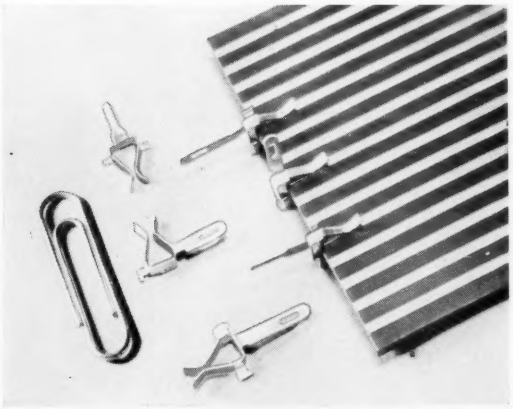


Fig. 3. Some of the different styles of beryllium copper contact are compared in size with an ordinary paper clip.

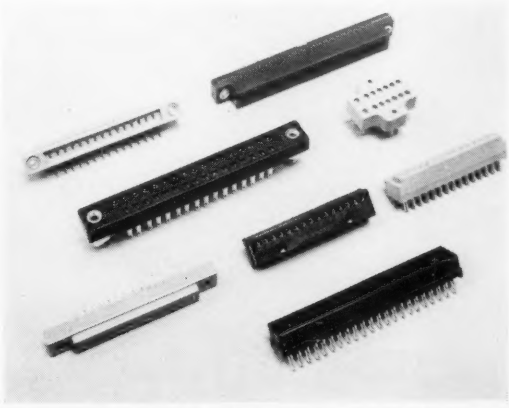
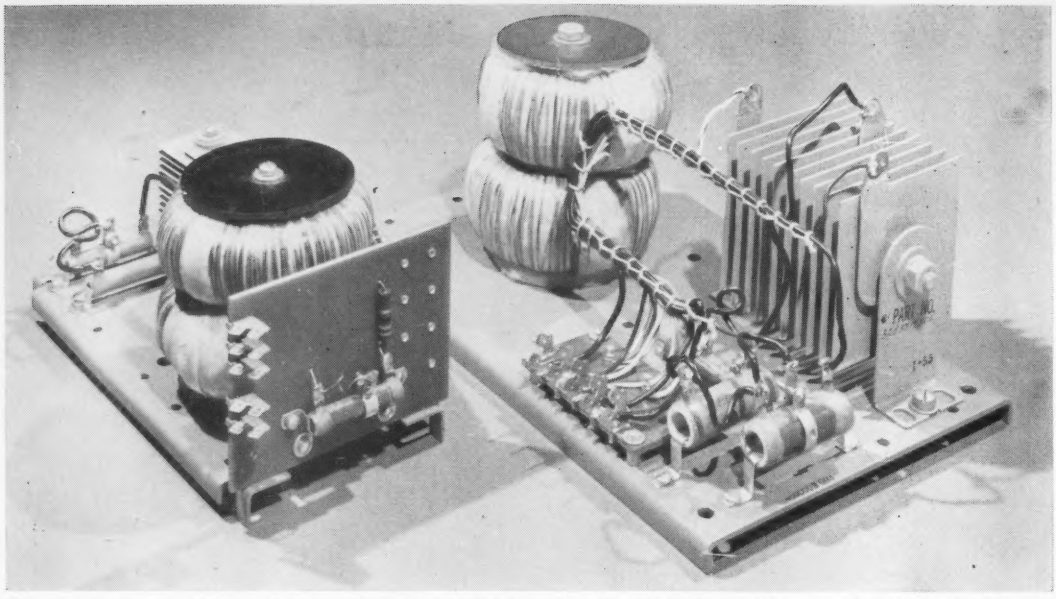


Fig. 4. A representative selection of a line of harmonica-like connectors for printed circuits is illustrated above.



If ac motors are used, reversing can be accomplished by using these Cypak amplifiers rated at 50 and 150 watt.

Use Cypak controls instead of relays

Control life increased because they have no moving parts to wear out

The results of long-term research and development in the study of solid-state phenomena make possible Westinghouse Cypak systems—static switching circuits for industrial control. They are essentially relay systems without moving parts.

Cypak Systems can perform any function now performed by relay systems in machine tool control, without benefit of contacts or other parts that would be subject to wear, erosion or environmental conditions.

The systems are composed of a small number of basic elements (none of which has moving parts), combined to perform specific functions. The functions performed are familiar to engineers working in computer technology or with relay and switching circuits. These functions may be thought of as building blocks that can be combined in a variety of ways to establish a desired relationship between the information fed into the control system and that taken out. In the broad field of

What are the advantages of these control systems?

CYPAK control systems can accomplish the same results as relays through what is known as a logic function approach. A logic function is simply a means of expressing a definite condition or arrangement of information. Relays can perform in logic function fashion, but have not been classified as such because they were never designed to accomplish a single, specific function.

Communications (cybernetics) experts have discovered that any set of conditions or arrangement of information, no matter how complex, can be described in terms of the four logic functions: AND, OR, NOT and MEMORY.

CYPAK is, first of all, a replacement for relays. Unlike relays, it has the decided advantage of having no moving parts, contacts, springs or other elements to wear or erode. This results in a tremendous increase in control life and reliability. The life of a CYPAK element is, in fact, estimated to be as much as fifteen or twenty times that of a conventional relay.

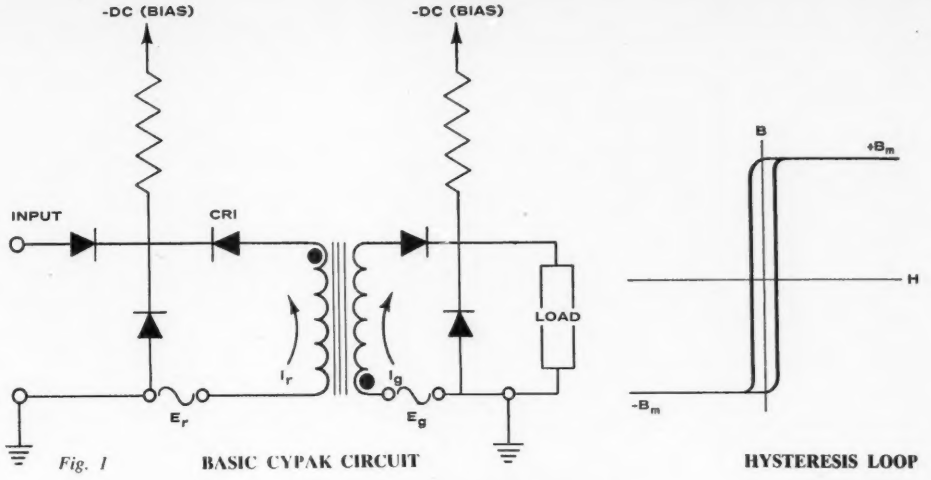


Fig. 1 BASIC CYPAK CIRCUIT HYSTERESIS LOOP

Basic Cypak circuit and hysteresis loop

cybernetics (or communications) they are referred to as **Logic Functions.**

The five elements that serve as components are known as **And, Or, Not, Memory,** and **Amplifier** circuits (see Table for description and symbols).

A recent component developed for use with Cypak systems is the contactless limit switch, symbolized as a coil to indicate its basic construction.

The **And** and **Or** functions are conveniently accomplished by semi-conductor diode networks. Selenium diodes and dry-plate units have been perfected for use in magnetic-amplifier circuits. They are highly reliable and relatively cheap. If environmental conditions preclude the use of selenium diodes, silicon diodes, which are crystalline units, can be used, but at a somewhat higher cost.

The components to accomplish **Not** and **Time** functions are more complex since they require information storage and amplification. To meet the design objectives, special magnetic amplifiers and transistors with appropriate circuit components have been used. Because there is often a weakening of signal through diode networks, it is desirable to use magnetic or transistor amplifiers to maintain the original signal strength throughout the system.

The principal method employed to maintain comparable cost was the use of very low power levels in the decision-making or logic components of the Cypak system. Current thinking is that these power levels should be as low as 10 milliwatts or even less.

Amplification from the logic to the power level is preferably accomplished by magnetic amplifiers. However, transistor amplifiers may be used, and there may be some cases where, due to the large amount of power to be handled, a standard electromechanical contactor would be desirable. This use of low power level inputs also makes it possible to use special push buttons and limit switches that have no moving functional parts or contacts. Photo transistors, for example, can easily be integrated into a Cypak system without amplification.

Here is how the Cypak element works: Two wind-

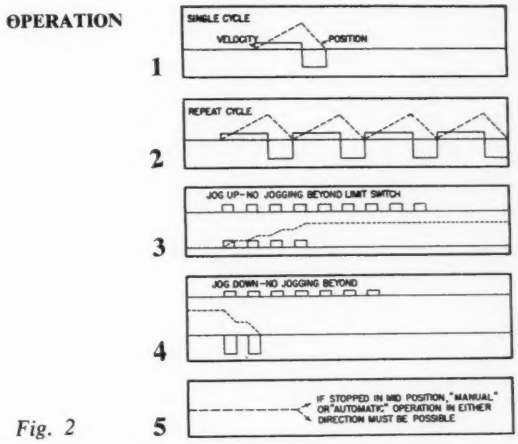
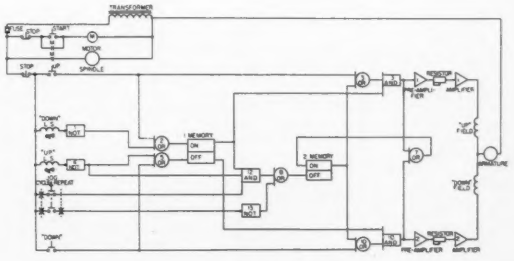


Fig. 2

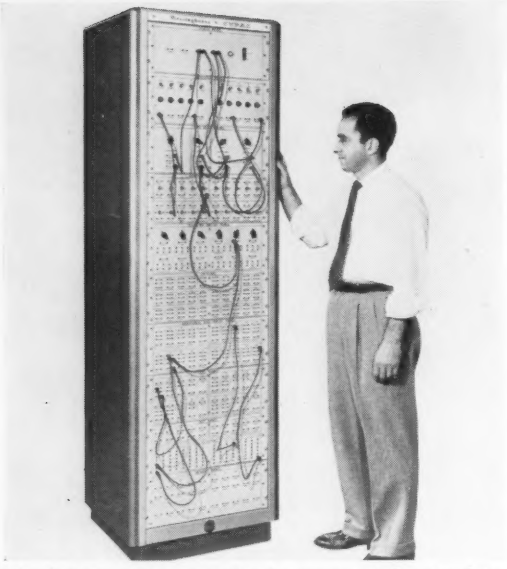
Operating sequence

This application to a drill head control demonstrates the elements found in many varieties of machine tool.



Cypak control circuit

System specified includes transformer, fuse, under-voltage relay and "start" and "stop" buttons for entire circuit.



Check before final assembly by means of this simulator using standard elements interconnected by patch cords.

Cypak controls continued

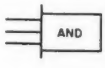
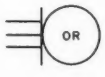
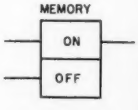
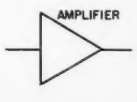
Long-term research and develop-

ings are put on a core of Hipernik V grain-oriented magnetic steel. The core provides a very sharp hysteresis loop (see figure). By proper rectifier circuitry, current I_g is made to flow in one winding (gate) so that it always drives the core towards positive saturation, as indicated by $+B_m$ on the hysteresis loop. Once the core has become saturated, it will absorb no more energy from the gate winding. Consequently, if, for the sake of discussion, the send winding reset is temporarily ignored, the result after the first cycle is a half-wave output at the load. This, of course, is not a controlled output.

To control the output, a current I_r is made to flow in the reset winding in such a direction as to drive the magnetic core towards complete saturation in the negative direction. By so arranging the phasing that the two currents I_r and I_g are 180 deg out of phase, the core oscillates between positive and negative saturation.

In so oscillating, the core absorbs all the voltage from both windings and no output appears. If an input is introduced in the reset circuit, as shown, it blocks

Table of Logic Function Circuits

CIRCUIT	DETAILS	SYMBOL
And	Output is obtained only when *all* of a given number of input signals are applied. In other words, if the given inputs are a, b, c and . . . j, the **And** function delivers an input.	
Or	Where an output is obtained when **any one** of a number of inputs is applied. Hence, given any input a or b . . . j, the **Or** function delivers an output.	
Not	In this case, an output can be obtained only when **no** input is applied. Therefore, given an input, a, no output is obtained; or given no input, the **Not** function delivers an output.	
Memory	The fourth type is the **Time** function. Actually, there are two types of time function—a limited one and an unlimited one. Limited means that, following an input, a specified time passes before an output is obtained. Or in other words, given an input a, an output is obtained from a limited time function after a specified time T. The unlimited time function, as the name connotes, will deliver an output following an input, until such time as a second input is fed into the system; the second input stops the output. Hence, given an input a, the unlimited **Time** function will deliver an output until input b is applied.	
Amplifier	Is an element whose function it is to drive solenoid valves, contactors or magnetic chucks. Although amplifier circuits include magnetic amplifiers, they may also use relays or electronic switches.	

ment in the study of solid-state phenomena made these controls possible

the rectifier CR1 so that I_r can no longer flow. Hence, the current I_g first saturates the core and then appears across the load on the next positive ½ cycle. The response is consequently ½ cycle.

The output has thus been controlled by an input signal which is the same as a relay in character. This circuit is not intended as an identical circuit for a Cypak element, of course. It is, however, the basis of the circuitry and consequently shows the method of operation.

This circuit emphasizes some important departures from previous procedures. First of all, Cypak is a low power system. The gate voltage is 15 volts, the reset voltage 8 volts, and the dc bias voltage 23 volts. The input power level is about 15 milliwatts and the output about 300 milliwatts.

As is apparent, this is not enough to perform power switching, such as switching a motor. This output is therefore used to control an output amplifier which itself operates the motor starter. The amplifier has an output of 115 volts ac, 60 cycles, in a number of standard sizes.

Developing the circuit

With these basic details established, a representative Cypak circuit can be developed. On the assumption that an order has been received for a control to operate a drill head automatically, the steps in control design will include the interpretation of requirements, development of the circuit, selection of components, testing the circuit, and finally, layout of the actual control. This application to a drill head control serves as an excellent illustration, since the operation includes elements found in many varieties of machine tool.

The modes of operation required (see figure), provide that in Operation 1 the drill head begins downward movement from its rest position with a velocity that is both variable and controllable. After the drill head reaches its lowest position, it then reverses direction and returns rapidly to its initial position. Requirements for Operation 2 are identical with those of Operation 1 except that in the second mode the cycle is repetitive. In Operations 3 and 4, jogging must be possible in both the up and down direction, with the stipulation that jogging cannot occur beyond the limit switches. For Operation 5, it is provided that the operator must be able to bring about manual or automatic operation in either direction if the drill head is stopped in mid-position.

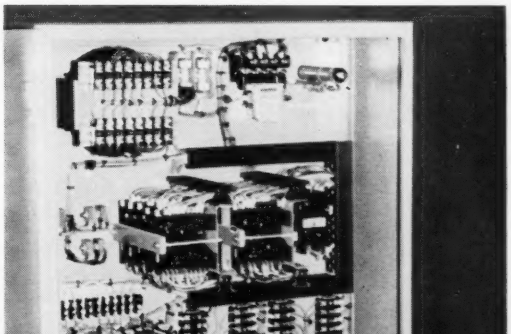
At this point it is worth noting that this graphic representation of requirements for machine operation is ideal for the purpose of the designer. Bar charts of this type are far more useful than a relay schematic diagram, since a relay schematic must be interpreted as a bar chart before the Cypak designer can prepare his logic diagram. In addition to a bar chart, pictures and drawings of the machine to be controlled are also very helpful.

As the first step in actual design, begin by specifying that the system (see figure), includes a transformer, fuse, and undervoltage protection relay and start and stop buttons for the entire circuit. Contacts on the relay will be used to start the spindle motor and a second stop button will be placed in the circuit ahead of all Cypak components so that the operation may be stopped at any time.

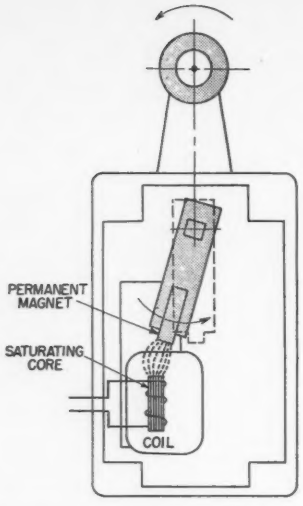
Since both up and down operation will be necessary, circuitry for both can be incorporated at this point without any concern for interlocking. In considering a method for reversing the drive motor, it is found, however, that an engineering choice is necessary. If the use of ac motors is proposed, reversing can be accomplished by the use of reversing contactors and two amplifiers, rated at 50, 150, or 300 watts (see figure). If costs are to be kept as low as possible, reversing could be obtained through the use of two pilot relays. Since it has been specified for this application that speed control is necessary for the drive motor, and since this motor is relatively small, it is equally possible that a split-field direct-current motor can be used. Although magnetic amplifiers are normally used to pass alternating current, they can be slightly and easily modified so that each will produce full-wave single-phase direct current. Use of modified magnetic amplifiers and the inclusion of a series resistor permits the use of the dc motor to obtain the necessary speed control.

Regarding the output circuits to be used, this decision is largely dependent upon the frequency of use which is to occur. If a large number of operations per minute is required, moving contacts should be kept to a minimum and magnetic amplifiers could be specified, even in applications where relatively large units are necessary. If few operations are required, however, economic considerations favor the use of the low-cost pre-amplifier with a pilot relay.

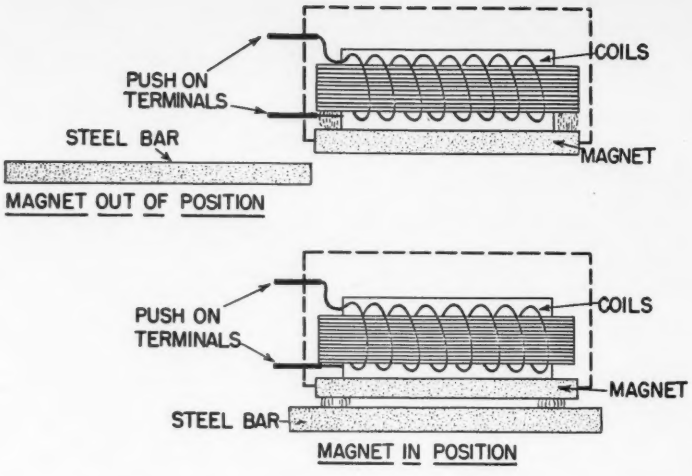
As the first step towards circuit interlocking, specify the inclusion of a **Memory** circuit. To illustrate its func-



Completed control for the automatic drill head shows how lay-out gives accessibility and efficient use of space.



Contactless arm–actuated switch



Proximity switch depicted here has no moving parts, is completely encapsulated

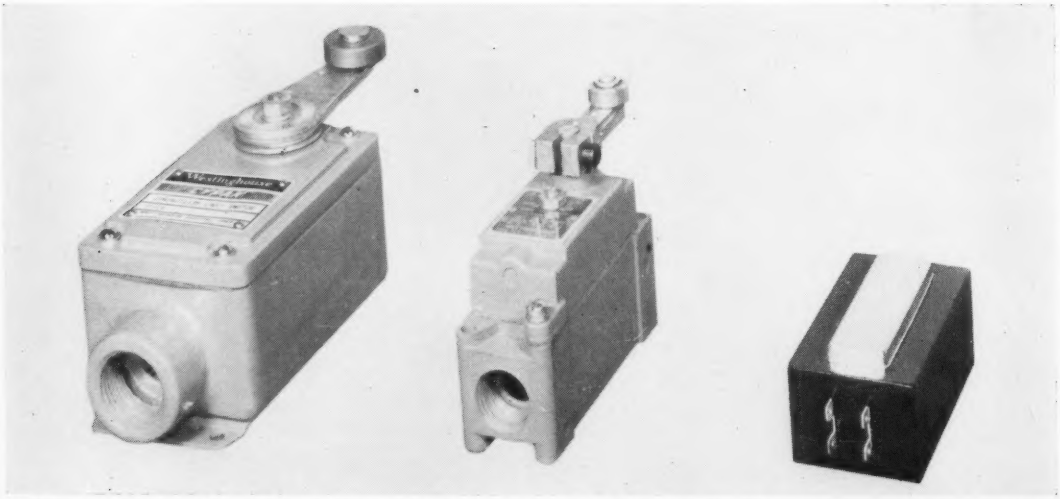
Cypak controls continued

tion, once the up push button is pressed, this circuit will remember the signal and its circuitry will continue to call for up operation after the push button is released. Since the element has two positions, pressing the up button causes the signal to be eliminated from the down circuit, so that conflicting instructions to the drive motor do not occur. To supplement the circuit, **And** circuits are also included. Accordingly, each of the motor fields requires two signals for its operation.

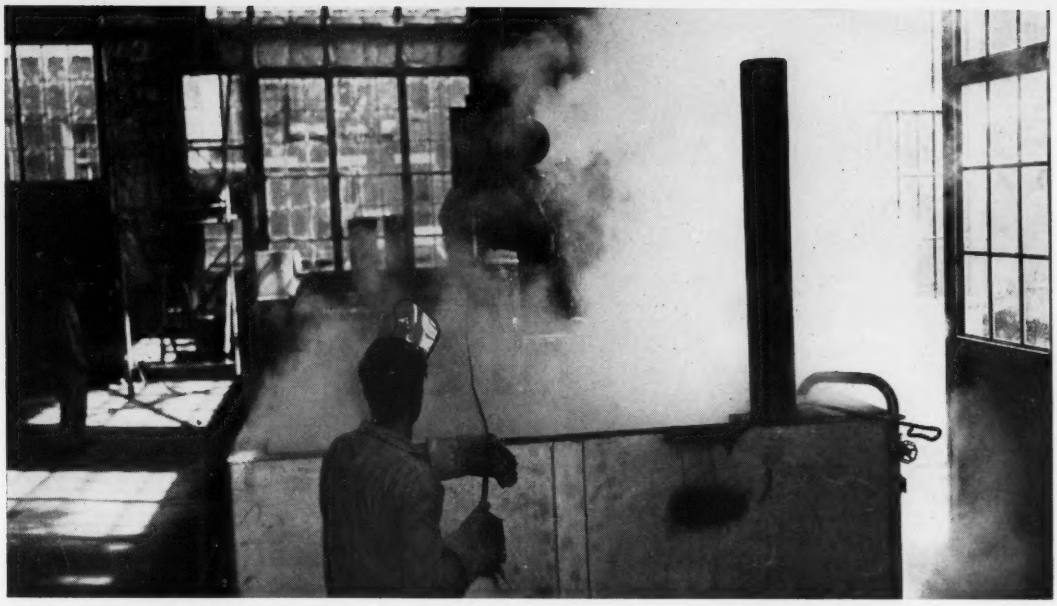
After providing the circuitry necessary to operate the drive motor in two directions, circuitry must also be included to stop the motor when the drill head reaches the end of its travel. This circuitry is achieved by the use of two limit switches, one to limit the up stroke and one to limit to down stroke. Since it is necessary to have a signal when the drill head is at mid-position and neither limit switch is supplying a signal, feed the limit switches through signal-producing **Not** circuits. At the end of each stroke the signal produced by the corresponding limit switch will switch off this circuit and reverse the electrical condition of the **Memory** circuit. **Or** circuits are now added to the over-all circuit to permit the **Memory** circuit to respond to the push buttons or the limit switches.

Limit switches suitable to our design are now available in several types (see figure). One type, the Westinghouse PLS limit switch, is a small, snap-action switch whose service life and reliability is unusual for switches of this type. If a snap-action switch of this type is employed, the circuit can be simplified by making use of the normally-closed switch contacts to eliminate the two **Not** circuits otherwise required. There is also a

Continued on page 69



(Left) Cypak contactless arm-type limit switch; (centre) Type PLS limit switch of the modern contact variety; (right) contactless proximity limit switch, without enclosure. It makes use of the change in impedance of a saturated core.



Surfaces to be bonded must be free from scale, dirt, grease, paint and so on; are receiving the steam bath treatment.

Protect steel with an aluminum coat

Aluminum coated low-alloy or mild steels are now being used by design engineers to replace the costly high alloy steels for hot-air tubes and diesel components.

Now, for the first time, a process is available commercially which seems to offer a solution to many corrosion problems.

The process, known as Aldip or Alumicoat, was developed and patented by General Motors. It has been licensed to some firms for their own use, but the first licensee with rights to its general commercial use is the Arthur Tickle Engineering Works.

As the name implies, steel (or one of its alloys) is given a relatively thin coating of aluminum. Either pure aluminum or an aluminum alloy can be used for this purpose. A metallurgical bond at the interface is obtain-

What the process does

Low-alloy or mild steels, aluminum coated to give the required resistance to oxidation and corrosion, are now being used by design engineers to replace costly high-alloy steels. Jet aircraft components, ships' boiler hot air tubes and economizer elements, diesel components and petroleum refinery equipment, are some of the current uses for the process.

In the diesel field, the process offers promise in solving some of the corrosion problems that are increasing as the result of the trend to higher temperatures and pressures for obtaining higher specific engine outputs and also because of the economic need to burn the less costly, but often more corrosive fuels.

In the Alumicoat process, pure aluminum, or one of its alloys, is used as a coating. Pure aluminum, has, in fact, been found to offer excellent resistance to attack by industrial gases and corrosive media, especially those containing sulphur compounds. The aluminum penetrates the steel to a depth of 0.0001 to 0.0005 in with approximately 0.001 to 0.007 in aluminum coating on the surface. The thickness of the coating, which varies with the material used, can be controlled by timing the immersion period.

ed and it is this surface which has aluminum diffused in the ferrous material to an appreciable depth, that alters the corrosion-resistant qualities of the ferrous metal.

A principal feature of Alumicoating is its flexibility of application with respect to different shapes. In one case, plenum chambers for a particular refinery process were to be dipped. The shape was irregular and complicated by the fact that some of the piping connections extended beyond the inner wall and into the plenum All interior and exterior surfaces, with the exception of flange connections, had to be treated. The process can cope with such requirements.

The initial step is cleaning. Surfaces to be bonded must be free from scale, dirt, grease, paint and so on. The method used must be appropriate to the material and the shape. Steam stripping, sand blasting and hot caustic dips are commonly used methods.

Areas not to be coated are masked off. A special titanium compound was found to be most suitable. This is applied to the surface and allowed to harden.

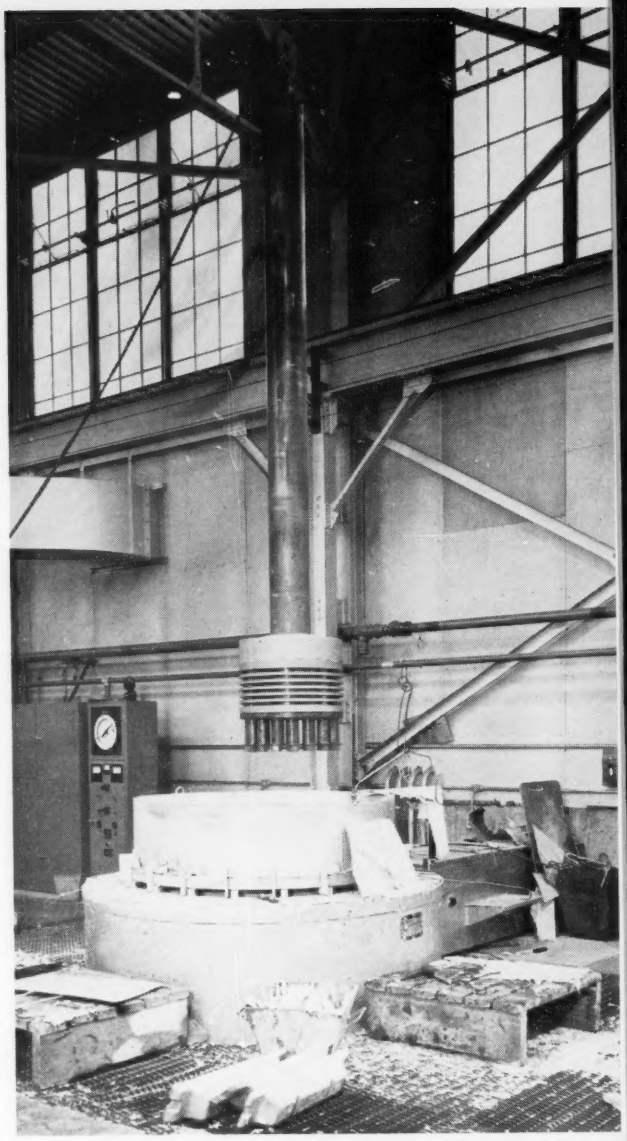
Fluxing is the next operation. A special furnace with electrical heating equipment is necessary. The top is covered with rolling doors, opened only far enough to admit the piece to be fluxed. The fluxing bath is a proprietary concoction containing such chemicals as sodium and potassium chlorides, aluminum fluoride and cryolite. Its temperature is held above 1,200 F at a point determined by the particular ferrous alloy to be alumicoated.

The part is lowered into the bath, where it remains for a calculated period. When the part is completely fluxed, it is drained and is ready for dipping. During this process the temperature of the part is raised so that it is equal to or above that of the aluminum dip.

The next step is submersion in the molten aluminum. There are two aluminum furnaces; one is narrow and deep whilst the other has larger opening dimensions but less depth. This provides flexibility in handling parts of different shape and also allows for production using two different aluminum alloys.

As an example of how the selection of the aluminum alloy affects the process, consider pure aluminum and an alloy having 12% silicon. First, the pure aluminum requires a higher temperature (1,300 F-1,400 F) for both dip and fluxing bath. Where these temperatures might affect the temper of the metal or produce distortion, the silicon alloy may be used, unless other factors are concerned. Temperatures would then be around 1,240F-1,250 F.

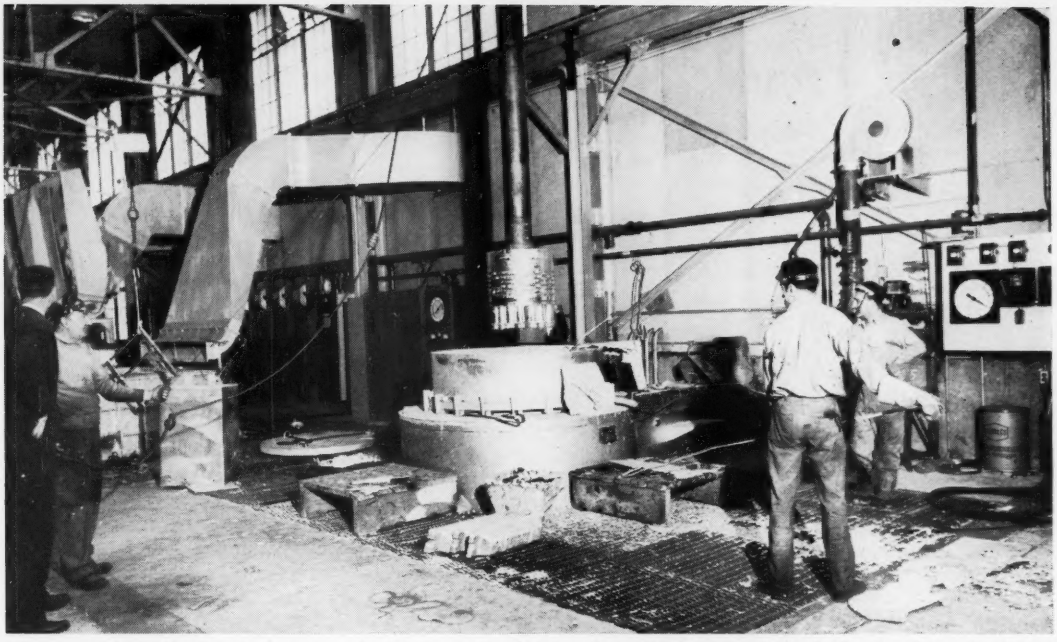
Pure aluminum provides better corrosion resistance



Large diesel piston, shown with piston rod attached, before being immersed in the bath of molten aluminum.

Untreated Steel				Aluminum-coated Steel			
	Temp. (deg F)	*Time (hrs.)*	*Weight change %*		*Temp. (deg F)*	*Time (hrs.)*	*Weight change %*
18-8 Chromium Nickel ...	1350	24	—17.0	Plain Steel	1350	192	+0.1
25-20 Chromium Nickel ...	1350	4	— 8.3	18-8 Chromium Nickel	1350	192	+0.1
27% Chromium Steel	1350	24	— 8.4	Plain Steel	1700	48	+0.3
				18-8 Chromium Nickel	1700	48	nil

Note: The weight change for untreated steel is after corrosion scale was tapped off.

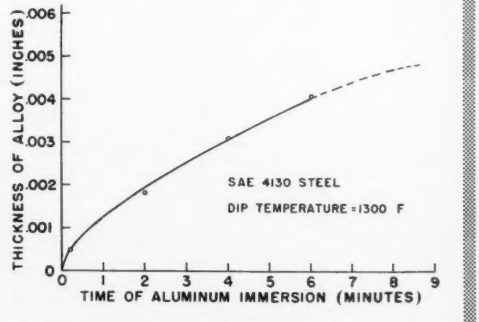


The same piston head as is shown on the left immediately after being taken out of the bath of molten aluminum.

Metallurgical bond formed at interface improves corrosion-resistant properties

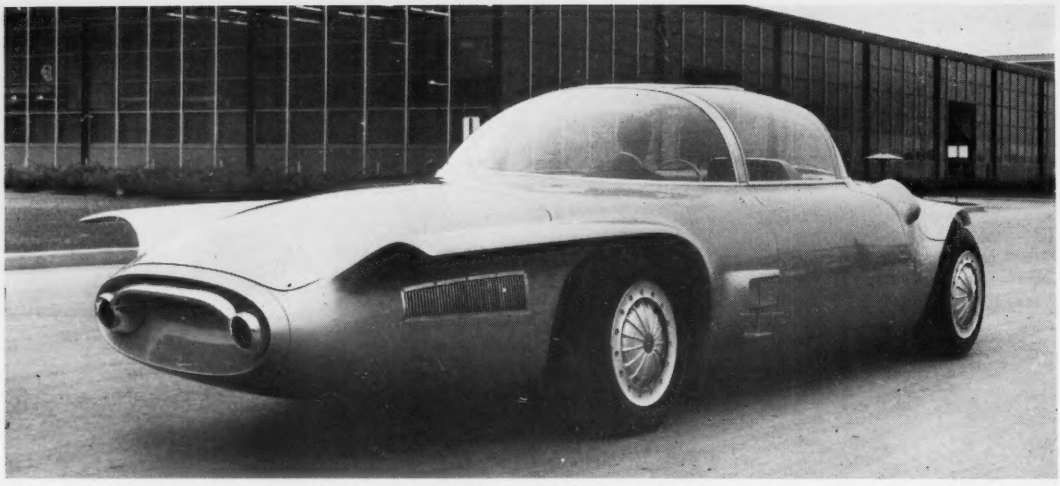
at the lower temperatures. Corrosion resistance of the silicon alloy would be approximately the same at elevated temperatures.

During the dipping, aluminum penetrates the steel to a depth of 0.0005 to 0.002 in., the aluminum clinging to the outside being ordinarily about 0.0005 to 0.005 in. thick. Coating thickness is determined by the material used and the immersion time. If a very thin exterior coating is desired, the piece can be returned to the flux bath where the excess aluminum is removed while the depth of the aluminum diffusion in the steel is increased. This would also occur if the temperature of the piece when installed and in operation happened to be above the melting point of the aluminum. ★



Graph showing the thickness of the iron-aluminum compound plotted against the dip time.

Piston head after it has received the whole treatment of coating with aluminum and subsequent clean-up.



Three-quarter rear view showing the twin exhausts of the GM XP-500 experimental free-piston generator turbine car.

Is the free-piston, gas turbine car here?

By this application of an old idea, a free-piston diesel engine is combined

By P. E. Biggar

If you have followed the development of the gas turbine (articles appeared in the September 1955 and March 1956 issues of Design Engineering), you will remember that engineers are faced with two serious problems. First, the high temperatures at which the turbine must work demand expensive materials: second, unless it is fitted with a bulky and costly heat exchanger, the fuel consumption of the turbine is altogether too high.

Now General Motors have come up with a new application of an old idea that promises to avoid these difficulties, perhaps to bring the gas turbine a long step toward use on the road. This idea is to combine the turbine with a free-piston diesel engine. The function of the engine is merely to supply the turbine with hot exhaust gas under pressure; the turbine does all the external work. No heat exchanger is required and the over-all efficiency is as high as that of the diesel engine.

So this fast-looking General Motors experimental car, which they call the XP-500, is the first car—and almost the first road vehicle—to be driven by the free-piston engine and gas turbine combination. Let us see how it works.

The engine works on the two-stroke, compression-ignition cycle. It has opposed pistons, which come close together at the inner ends of their strokes, compressing the air charge so as to ignite the fuel which is sprayed in from the injector at the proper instant. The pistons are driven apart and the larger, outer pistons draw in a fresh air charge into the two compressor cylinders. Meanwhile, air is being compressed in the end cylinders, to act as a buffer or spring, first stopping the pistons in their outward travel and then causing them to bounce back for the next cycle.

At the same time, the inner (or working) pistons have uncovered the exhaust and intake ports as they move outward. The working cylinder is scavenged and highly supercharged by air pumped into the central space from the two compressor cylinders. The exhaust gas rushes out on its way to the reservoir (used to smooth out pulsations) and the turbine. The exhaust back-pressure may be as high as 100 psi, so that the diesel engine has all it can do just to pump in scavenging and supercharged air at a still higher pressure. In fact, in one test, the engine gave over 230 psi bmep.

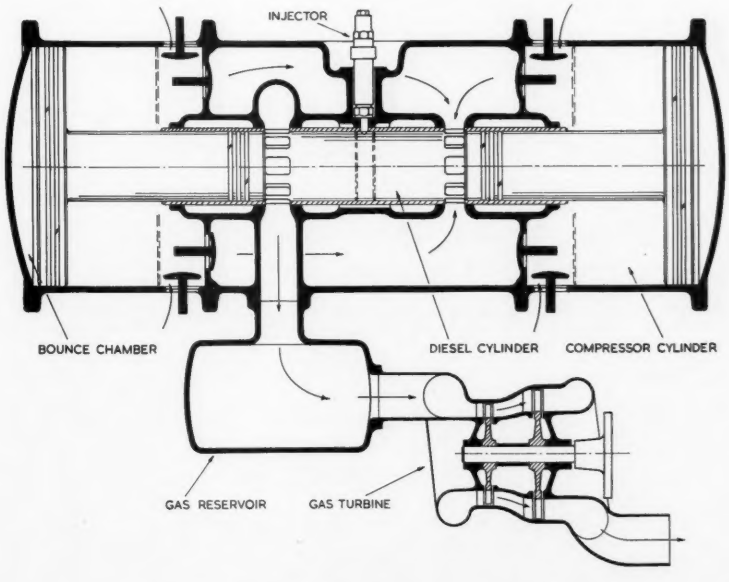
It has been claimed that the free-piston engine has neither crankshaft nor connecting rods. This is not strictly true, as some mechanical linkage is needed to keep the two piston sets in phase. Also, for road vehicles at any rate, the problems of starting and driving the injection pump are much simplified where there are external moving parts. We call it "free-piston," but the pistons are not strictly speaking free.

Comparing the new combination with the piston-engine-and-exhaust-turbine powerplants now almost standard in piston-driven commercial aircraft (three exhaust turbines feed power into the crankshaft), we find that the engine has been reduced to its most rudimentary form and is now merely a source of supply of exhaust gases for the turbine, which does all the external work.

Why has the free-piston engine and gas turbine not been tried out before in cars? We don't quite know, but, according to Profs. A. K. Oppenheim and A. L. London, of Stanford University, who made a complete design analysis of free-piston engines in 1950, this is an uncharted field, with pitfalls for the unwary designer. But the bait they hold out is an over-all thermal efficiency of 42% and a fuel consumption of 0.33 lb/hp hr. If the machine can produce a performance like that, it is certainly worth while to spend some time and money to find out how it can be done. And that is evidently what General Motors had in mind when building this experimental car, the XP-500. ★

The free-piston engine can burn animal, vegetable or mineral oil, acts as a generator for supplying the gas turbine.

with a gas turbine and seems very promising for use in cars of the future



Schematic layout of free-piston, gas turbine engine.

Free-piston engine is source of supply of exhaust gases for the turbine, which does all the external work.

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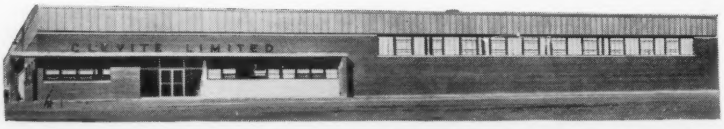

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File

New booklets and books written for you

DETAILS ARE GIVEN in a brochure from the HALOID COMPANY of Xerox Model 1218 copying equipment.

This copies engineering drawings or anything written, typed, printed or drawn up to 24 in. by 36 in., by xerography onto offset paper masters for run-off of 12 in. by 18 in. multiple copies on an offset duplicator. (210)

• • •

Aluminum nameplates

A NEW BROCHURE issued by NORTH SHORE NAMEPLATE INC. illustrates and describes Therma-Cal all-purpose aluminum nameplates for use on irregular surfaces and crinkle finishes. Shown are typical applications: dials, scales, instruction plates, schematic drawings, insignia and trademarks which the company's customers have had permanently color-anodized and etched into the surface of thin-sheet aluminum.

Photographs illustrate two bonding methods which can be used (solvent activation or heat activation) and the advantages of Therma-Cals are completely detailed. Among these are: no rivets, screws or pins needed; no holes to drill; reduces installation costs; can be used on any surface; unlimited shelf life; wide variety of colors and designs available. North Shore will also design or adapt custom machinery for automatic application of aluminum nameplates on the production line. One page of the booklet is a catalog sheet describing accessories which can be obtained by Therma-Cal users—including photographs, description and prices. (211)

• • •

Self-lubricating chain

IN A BROCHURE from the WHITNEY CHAIN CO. are details of their self-lubricating roller chain.

This is an American standard roller chain, having unusually high strength and impact resisting sintered steel bushings. The bushings are manufactured under rigid quality control. These bushings have many minute, interconnecting pores which open to the bushing bearing surfaces. This porous structure is impregnated with lubricant at the time of manufacture.

When this self-lubricating chain drive is put into operation, the lubricant in the bushing expands and flows over all the bearing surfaces, providing the vital film of lubrication. As friction and temperature are reduced, the lubricant contracts and is reabsorbed by the bushing. (212)

• • •

DC amplifier

A RECENTLY INTRODUCED direct current amplifying instrument is described in a four-page data folder No. 80-1 now available from ROBERTSHAW-FULTON CONTROLS (CANADA) LIMITED.

The folder contains descriptions and schematic drawings of four typical applications of the instrument, as well as general technical information concerning voltage and current amplification. The d-c amplifier is claimed to be suitable for most industrial and laboratory direct current measuring problems. Because it is electromechanical in operation, it has good zero stability and current as low as a few microamperes can be greatly amplified.

The compact unit is housed in a small case of cast aluminum, rubber gasketed to prevent dust, water and other foreign matter from entering. Special models, for installations where resistance to weather and other hazards is important, are also described in the folder. (213)

• • •

Tapes for graphs

DETAILS ARE GIVEN in a brochure from Chart-Pak, of a method for making graphs, organization and flow charts or office and plant layouts.

Basically, the method consists of preprinted commonly recognized lines, bars, shapes, and symbols used in preparing graphs, charts, and layouts. They are printed on adhesive-backed, pressure-sensitive tapes or sheets.

Symbols and shapes are professionally drawn and precision printed. You stick down what you want where you want it. Plastic planning boards with printed grids are available and recommended for greater efficiency. For corrections or changes, merely peel off and replace the tapes, symbols or shapes.

Chart-Pak materials can be purchased individually as needed, or in handy and complete kits for preparing organization and flow charts, graphic charts and office layouts.

The tapes are versatile. They are used for striping, masking, trimming, decorating, forms, reports, map overlays and packaging. Precision slit tapes are used on printed circuit master drawings. (214)

Book Department

Mechanism

This is the first volume in a mechanical engineering series, by **Joseph Stiles Beggs,** P.E. It was written for the course in advanced kinematics developed by the author at the University of California.

The design of a machine takes place in two phases: first, the selection of the mechanism to produce the required motions; second, the design of the members of the mechanism. This is not to suggest that the two phases are independent. An optimum solution to a design problem cannot be obtained by solving first one phase and then the other.

After a mechanism has been chosen, the attempt to design satisfactory members may show that the choice was a poor one, in which case the mechanism is modified on the basis of this information and the members re-designed accordingly. In this way a satisfactory design is generally achieved.

Mechanical design is thus seen to be a cut-and-try process. Because of this, it is obvious that the more experience a designer has, the more quickly he is likely to reach a satisfactory solution to a design problem.

One of the first things a designer must know when he starts thinking about a new design is "how many and how much." Large quantities of a manufactured article mean that the designer can design for elaborate tooling such as is required for a complicated die casting. The large tooling cost spread over a large number of pieces may amount to a very small sum. As the number of pieces decreases, the tool costs eventually become prohibitive and sand castings become more attractive. If only one or two pieces are to be made, a weldment may be cheaper or the piece may be hogged out of solid metal. On the other hand, the demand for a product (assuming that it is desirable) will depend largely on the selling price.

In choosing a mechanism, a designer is at a great advantage if he is familiar with many mechanical movements. Just as the professional musician has a large repertoire, the mechanical designer should have a large repertory of mechanical movements from which he can select those that suit the job at hand. No matter how ingenious he may be, a designer can hardly hope to invent at will devices which the human race has been thousands of years discovering. By familiarizing himself with the known building blocks of mechanism, he can use his ingenuity to combine them in new devices. For that reason one complete chapter is devoted to mechanical movements.

The price is $7.80 and the publisher McGraw-Hill Company of Canada.

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Quotes

Points from current papers and speeches

A tin base alloy is used for the die-cast tip that houses the steel writing ball of ball point pens made by The Biro Swan Company, states the **Quarterly Journal of the Tin Research Institute.**

As is well-known, this type of pen transfers the ink to the paper by the rolling action of a very small steel ball, the diameter of which is only 0.0394 in. (1 mm). In order that the transference of the ink shall proceed at a perfectly smooth and uniform rate from the outset until the reservoir has been emptied, it is essential that the clearances between the ball and its housing undergo no appreciable variation or enlargement. Such enlargement of the clearance could result from deformation of the cup which retains the ball under the pressure exerted when writing. Calculation shows that this stress in the ball seating is much higher than would be imagined by anyone using a pen, but is within the capabilities of a good quality tin-base alloy to sustain. In view of the excellent bearing qualities of tin alloys and due to the fact that the ink itself serves as a lubricant between the ball and its seating, the enlargement of the housing due to abrasion is kept within the required limits.

• • •

Plastic boats

One of the earliest applications for reinforced plastics was in the manufacture of small boats—and it has been a growing application ever since. **(Vibrin News,** Vol. 2, No. 2.)

The reinforced plastic boat offers several impressive advantages over wooden or metal boats. It is much stronger, much lighter, absolutely leak proof and requires a minimum of maintenance, all features which are available to the small boat owner at no premium in price.

This year the picture of steady progress was again present at the Canadian National Sportsmen's Show in Toronto. Plastic boats made up about 20% of the craft exhibited.

The established plastic boat manufacturers were represented by extended lines, and while the car-top type of boat remains popular, emphasis appears to be shifting to the more highly styled craft. It was with this latter type that two of the older boat builders, one with an enviable reputation in wooden boats and the other a leading manufacturer of the aluminum variety, chose to make their entrance into reinforced plastics.

The whole small boat field is a growing one, as the average person has more leisure and more money to enjoy this increasingly popular summer pleasure. New boat trailers now available—not made from reinforced plastics — have helped to make this form of recreation available to a wider circle; boat owners can live hundreds of miles from water and still enjoy this particular pursuit.

• • •

Aluminized valves

A new aluminum coating process now in use in the Valve Division of Thompson Products Co. of Cleveland, promises to alleviate the problem of valve burning, bringing considerably improved economy to manufacturers and operators, states a recent **Aluminium News.**

The problem of burned valves is aggravated by increasing operating heats caused by the trend to higher compression engines. This subjects the moving parts of the engines, and particularly the valves, to severe wear and tear. As operating temperatures increase, metals having the required mechanical properties, as well as resistance to oxidation and corrosion, are more difficult to find and are likely to be expensive.

Performance tests on the Thompson-produced aluminized valves indicate that valve life has been increased from two to five times with this technique. The aluminizing process forms a thin, hard iron-aluminum alloy between the underlying steel of the valve face and the pure aluminum surface. This imparts to the valves the desired oxidation-resistant and corrosion-resistant properties without affecting their ductility.

The technique was originally developed by General Motors Research Laboratories to extend the service life of exhaust manifolds and mufflers by a protective coating. It proved practical and the process was tried on engine exhaust valves. It is now being used by Thompson Products, under licence from G.M., for coating valves of Chevrolet and Pontiac engines.

• • •

Pump maintenance

From a study of a recent survey into the most common causes of pump shutdown or failure the following facts emerged: 20% of failures were due to worn packing or shaft sleeves. 20% of failures were due to bearing troubles. 18% of failures were caused by entry of foreign material into the pump, plugging or damaging the impeller. The remaining 42% of failures covered general wear of bushings, eye rings, impeller or casing, and so forth.

This shows that almost two thirds of the troubles experienced were avoidable —a fact that should make every engineer charged with the responsibility of maintaining pumps ponder the question —"Is our pump maintenance adequate?" An article in The **Bepco Journal** No. 6, 1956, is designed to help you answer this.

• • •

Puff camera

Details are given, in **Canadian Isotope Newsletter,** Vol. 5, No. 5, of a new type of radiography camera now undergoing final field trials. Designed by Isotope Products engineers, this Puff camera operates on an entirely novel principle—the active source is blown into position by compressed air.

The success of an earlier projection camera as a tool for the handling of large cobalt sources for foundry operation led Lorie Meray, Isotope Products design engineer, to consider a similar piece of equipment on a smaller scale. Enquiries showed much interest in a smaller, mobile exposure camera, for handling 10 to 20 curies of iridium, and able to project the source out of the camera via a flexible tube to make an exposure.

Lorie, however, was faced with quite a problem. The projection camera drives its source to and fro by means of an electric motor. On a number of construction projects for which the new camera is designed, no power will be available. A portable source of power was needed. An air cylinder supplied the answer.

• • •

Cutting fluids

Metal cutting has long been an art, but now through the combined efforts of the physicist, the chemist, the metallurgist and the engineer, it is currently in the process of being transformed into a science, so states an article in **Lubrication.** Great strides have already been made in establishing some of the basic principles and underlying laws that govern the cutting and machining of metals. Although the story of metal cutting is far from being complete and much additional basic work still remains to be done, fundamental information is being accumulated so rapidly that the time is not far off when all the variables that influence the operation will be identified and their inter-relationship established.

One of the major factors contributing to the over-all advancement and progress of the metal cutting industry has been the availability of high quality cutting fluids. By the proper use of a suitable fluid, substantial increases in tool life and improvements in surface finish can be realized, both of which are of paramount importance to industry.

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• Following each announcement on the New Products and File pages are identification numbers in brackets.

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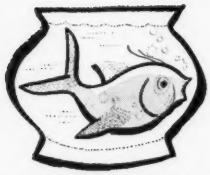
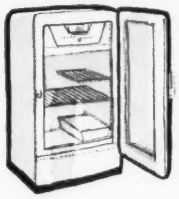
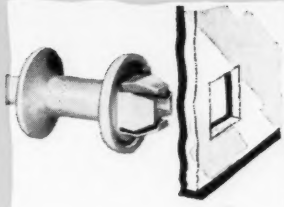
Here's Why
SHAKEPROOF PLASTIC FASTENERS
Do A Better Job At Lower Cost!



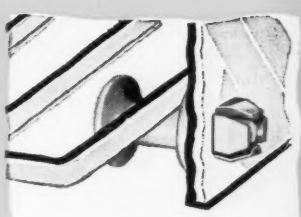
1. NON-CORROSIVE
Shakeproof Plastic Fasteners won't rust . . . often eliminate expensive corrosion-resistant metal fasteners.



In refrigerators, for example shelf supports must be completely rust-proof, easy to install, and very sturdy.

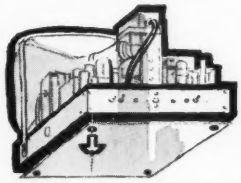


Shakeproof Plasti-Supports. Have the fastening action of a rivet . . . drive from one side only.

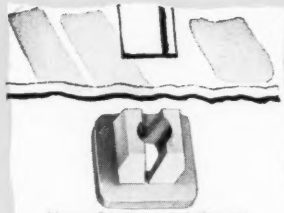


Won't chip or crack porcelain enamel. Save appliance manufacturers thousands of dollars yearly.

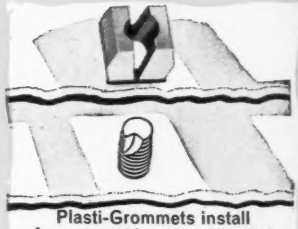
2. NON-CONDUCTIVE
Shakeproof Plastic Fasteners are made of excellent dielectric materials. They're self-insulating, often eliminate extra fasteners.



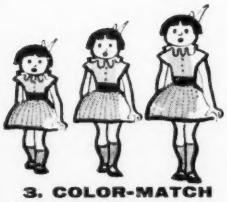
Mounting a "hot" TV chassis is critical. Manufacturers formerly used expensive bracket-to-bracket mountings.



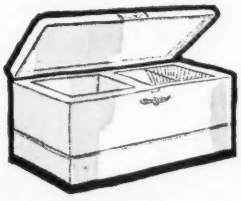
Now, Shakeproof Plasti-Grommets eliminate these complicated devices. Simply snap them in, then drive a screw to spread the legs.



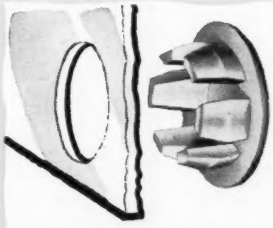
Plasti-Grommets install from one side . . . withstand loads of 500-600 lbs. . . . can save thousands of dollars on your production line.



3. COLOR-MATCH
You name the color . . . Shakeproof Plastic Fasteners will be matched to your color specifications.



In modern appliance, color-match is important to appearance when plugging left-over production holes.



Use color-matched Plasti-Plugs here and save the cost of expensive rack painting. They won't scratch or rust.

Just snap them in . . . and save yourself many production costs and headaches in matching colors.

Free Descriptive Literature

See for yourself how you can cut assembly costs and production time . . . and have a higher quality product. Drop us a note and we'll gladly send you complete descriptive literature on Shakeproof Plastic Fasteners.

CANADA ILLINOIS TOOLS, LTD.

177 Front Street, East
Toronto, Ontario

WORLD'S BROADEST LINE OF MASS-ASSEMBLY FASTENINGS

New products & materials

New items which can help you on the job

New electronic devices that use electrical charges in the air to control the temperature and level in the manufacture of products are announced by **Robertshaw-Fulton Controls (Canada) Ltd.**

The instruments operate on the principle of electrical capacitance by measuring changes in the electrical field between a specimen and the electrode of the instrument. This electrical field is set up in the air by the instrument.

Used in situations demanding a high degree of accuracy, some if these capacitance-type instruments can determine variations as small as one millionth of an inch and temperature changes of one thousandth of a degree.

One electronic device is designed to control the temperature in as many as one hundred different steps of a manufacturing process. Should trouble develop in the process, the device stops the production line, signals an attendant and locates the trouble. It can also be set up to bring about self-correcting action automatically.

Another of the instruments—the multipoint recorder — is capable of putting down on a twelve-inch circular chart electronic impulses received from ninety-six remote sources. (200)

• • •

Work platforms

The new line, which includes safety-tread work platforms, stairs, duck boards and floor racks, has been introduced to provide industry with custom-made Firm-Grip safety devices **(Bustin Steel Products, Inc.)** to meet specific requirements not covered by standard safety-grating equipment.

In addition to providing safety work platforms of any desired shape to meet particular applications, this new line enables the user to specify the exact height required, the precise type of safety grating desired and the load limit which the structure must meet.

Illustrated are one large and two small work platforms, each showing a different type of construction, and a floor rack which is mounted on soft neoprene bumper blocks to cushion shock and reduce worker fatigue. (201)

• • •

Impulse generator

A microwave impulse generator (Model IG-118) designed by **Empire Devices Products Corp.,** produces pulses of fractional milli-micro-second duration, obtained by discharging a coaxial line into a load impedance through a pair of discharge contacts. Pulse duration is determined by the length of the charged line.

The output pulses produce an exceptionally broad RF spectrum: 100 to 10,000 mc flat within ± ½ db. This known output level of broadband pulse energy can be used to measure the noise figure; determine bandwidth; study transient responses; as a calibrating standard for noise and field intensity meters; to test noise susceptibility of receivers; for receiver alignment; and as a signal source for broadband amplifiers or for evaluating spectrum analyzers. A special version of the IG-118 producing usable power up to 40,000 mc can be obtained. Maximum peak power output is 9,000 microvolts per megacycle of bandwidth. Maximum average power output is 79.5 db above KTB. Output level is continuously adjustable over a 20 db range. Peak output is calibrated in terms of db above 1 microvolt per megacycle of bandwidth. Pulse polarity is automatically reversed once every 10 seconds. Pulse width is 0.00005 microseconds. Repetition rate is continuously adjustable from 2.5 cycles to 2,500 cycles per second. Output impedance is 50 ohms. (202)

• • •

Control valves

A complete line of solenoid pilot-operated control valves, built to JIC standards, is announced by **Valvair Corporation.**

Known as the Speed King series, the new valves meet, or exceed, the requirements outlined in paragraphs A2.5.8 and A6.4 of the JIC Pneumatic Standards for solenoid-operated valves, the manufacturer says. JIC features include: moisture and dust-proof solenoid enclosure sealed to prevent entrance of splashing liquids

Speed-King control valve.

or airborne contaminants, safety solenoid cover which renders the valve electrically inoperative when cover is removed and an integral junction box large enough to accommodate 6 inch taped pigtail leads. The junction box has a threaded conduit connection. (203)

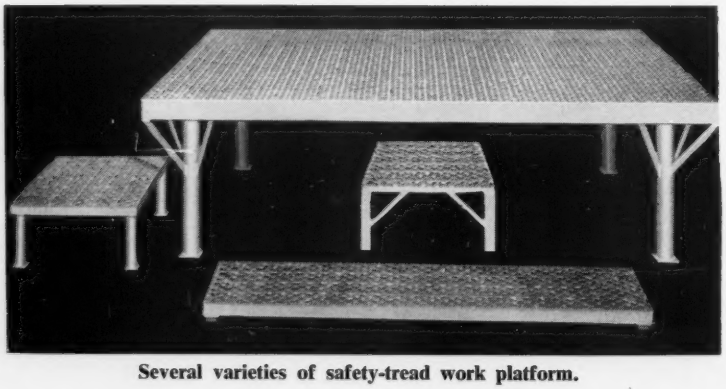
• • •

Self-locking nut

An improved self-locking, spline type nut has been developed by the **Elastic Stop Nut Corporation of America** to provide tighter grip and smoother installation in aluminum and magnesium alloys.

Designed as self-wrenching fasteners for industrial and aircraft applications, Type ND2398 spline nuts serve as blind mounting fasteners when it is desired to have an attached nut for ease of maintenance.

The new spline nut includes several important features, such as a counterbored shank to accommodate AN thread length bolts used in aircraft construction. A chamfered pilot on the shank centres the nuts on insertion and assures equal broaching of the installation hole wall by the splines. A chip relief groove, immediately behind the pilot, allows actual broaching of the hole, minimizes



Several varieties of safety-tread work platform.

SWITZERLAND FOR WATCH MOVEMENTS

JENKINS FOR VALVES!

Making Quality Valves Is Our Business — *Our Only Business.*

Sold through leading industrial distributors

JENKINS VALVES

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TRADE JENKINS MARK

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It pays to deal with specialists.

When it comes to precision and accuracy, nobody in the world beats the Swiss in the complicated manufacture of fine watches. They are craftsmen. More than that . . . they are *specialists.*

And, in another field where precision is of absolute importance, Jenkins holds the reputation of being the foremost specialists in the field of valve manufacture.

For Jenkins Bros. Limited has been making valves for generations . . . and *only* valves. Practical experience and concentration on producing only the best have won Jenkins world-wide fame for the finest in valve manufacture.

That's why, when you specify Jenkins valves, you can rest assured that their dependability is unrivalled . . . you can buy with the confidence that you are buying from specialists.

New products *continued*

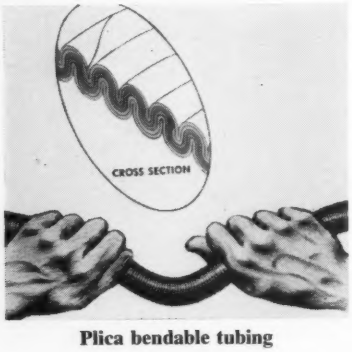
hoop stress in the work and ensures proper seating. The reduced flange diameter of the new spline design permits effective use in close clearance applications. (204)

• • •

Bendable tubing

A new line of bendable tubing, having unusual installation advantages, known in Europe and elsewhere as PLICA, is now being made and sold in the U. S. by **The Flexaust Company** under exclusive rights acquired from Switzerland.

In Switzerland and other countries, Plica has been used extensively during the past ten years as electrical conduit. It has shown itself to be ideal for burying in concrete, ceilings and floors. Since it can be cut with a hacksaw or knife, bent by hand to stay bent and fits all standard connectors, installation times are substantially reduced.



Plica bendable tubing

The tubing has a three-ply wall and can be made in almost any desired combination of ferrous and non-ferrous metals, fiber, paper or other material. It is made by fully automatic machines in continuous lengths and has high wall strength, watertightness and sharp bending radii.

Plica tubing, made of copper, brass, aluminum, steel, asbestos, fiber, paper and combinations of these materials, is used for lubricating, cooling and other non-corrosive liquid lines, hot and cold air ducts, mechanical protection and insulation of pipes, flexible shaft casing and for a wide variety of other uses. (205)

• • •

Electronic regulated rectifiers

A recent first in rectifier design and development is the electronic regulated unit of **Canadian Line Materials Limited.** It produces a non-variable DC output voltage, even with a plus or minus 10% AC input voltage variation.

The units are used to charge and maintain, at a constant voltage, large station and communication type batteries.

Another exclusive feature is that additional units can be added in parallel to other regulated rectifiers, when increased output demand is required. (206)

• • •

TV tubes

An entirely new line of television receiving tubes, which will reduce series-string heater power by 25%—thus easing design problems in the trend to smaller sets—is available from **Canadian General Electric Company's** Tube Department.

These tubes will draw 450 milliamp of heater current and are designed to meet series-string circuit requirements of portable television receivers. C.G.E. production facilities are ready to turn out 450 milliamp versions of any or all of some fifty popular 600 milliamp controlled warm-up types, as required. The company expects that the 600 milliamp series-string line of tubes will continue to be used in the larger television sets.

It is claimed that a 450 milliamp series filament string operating at 117 volts will use only 53 watts of power, as opposed to the 70 watts consumed by a 600 milliamp string.

Significant advantages in using lower heat power show up in several ways. For instance, about 20 cents can be saved by eliminating (or reducing in size) the heater dropping resistor |(207)

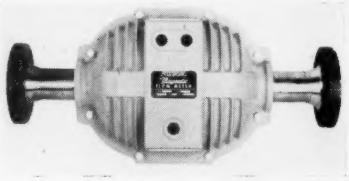
• • •

Magnetic flow meter

Previously limited to a minimum line size of 2 in., the Magnetic Flow Meter, product of **The Foxboro Company,** is now available for 1 in. flow lines. The smaller meter offers all the advantages of the larger instruments (2 in. and up), namely: over-all accuracy of ± 1% of full scale throughout the entire scale; no restriction of flow; linear flow readings; performance unaffected by pressure, viscosity, density or changes in conductivity of the flowing liquid.

The unit consists of a non-magnetic flow tube with an insulating liner containing flush-mounted metallic electrodes and surrounded by an AC electromagnet. When a conductive liquid passes through the tube, an alternating voltage is set up between the electrodes which varies linearly in proportion to the rate of flow. Lead wires from the electrodes transmit this voltage output to a recorder, which is a chart record in appropriate units of flow.

The 1 in. meter will handle full scale flows of 10 gpm or greater. It permits accurate metering of the highly corrosive chlorine dioxide solutions used in the bleaching of paper pulp. Chemical processes involving small flows of brines,



Magnetic flow meter

slurries, acids such as HCl and H_2SO_4 solutions, and other difficult fluids (such as rayon viscose and rosin size) are other applications. (208)

• • •

Hydrogen thyratron

A new hydrogen thyratron, the BL-257, is announced by **Bomac Laboratories, Inc.** It is electrically similar to an E37A but ruggedized for vibration and high impact service, particularly for mobile and aircraft applications requiring moderately high power.

The tube is conservatively rated for 5g vibration from 60 to 500 cps and 3g for 500 to 1,200 cps and also for 60g high impact shock in any direction.

Hydrogen thyratron

Electrical ratings are 8.0 kv peak anode voltage, 90a peak current and 100 ma maximum anode current. It is rated for an ambient temperature range of —50C to 90C and for an altitude of 10,000 ft in air. The tube may be immersed in oil for high-altitude application. (209)

ANACONDA HAS THE ANSWER TO YOUR METAL PROBLEM*

ANACONDA'S "Formbrite"

a superior drawing brass that helps polish itself!

IN THE fabrication of countless stamped or drawn products, very often the most expensive operation is the finishing, which sometimes costs more than the metal itself.

Formbrite is a metal with an exceptionally fine grain structure. It provides a surface far superior to ordinary drawing brass. This superfine grain frequently permits savings up to 50% or more in finishing costs. In some cases only a simple "color buffing" is all that is needed.

Formbrite is no longer in the experimental stage and is being used in the manufacture of wheel covers, cigarette lighters, automatic pens and pencils, electric kettles, doorknobs, sun glasses, outdoor signs, wire for rivets, etc. . . .

. . . if you have a metal-finishing or any metal problem, consult

ANACONDA

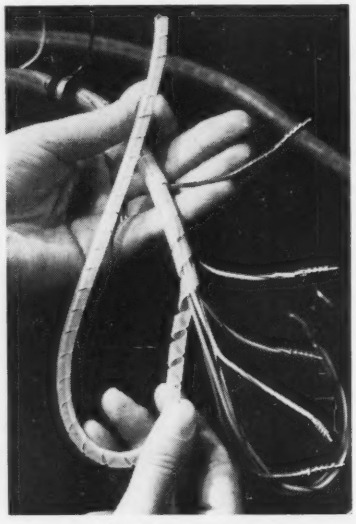
The specialized knowledge and experience of Anaconda's complete Technical Department is at your service. If you have any metal problem let Anaconda solve it for you. Don't hesitate to call on us. Anaconda American Brass Limited—Main Office and Plant: New Toronto, Ontario; Montreal Office: 939 Dominion Square Building.

ANACONDA—First IN COPPER, BRASS AND BRONZE

Design news in pictures

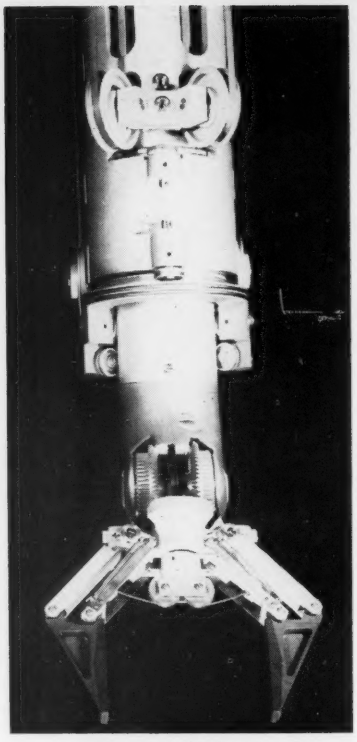
Analogue computer

Recently installed in the electronics division of the Canadian Westinghouse Company, one of the largest analogue computers in Canada. It will solve servo-mechanism problems and cut time off other complex projects.



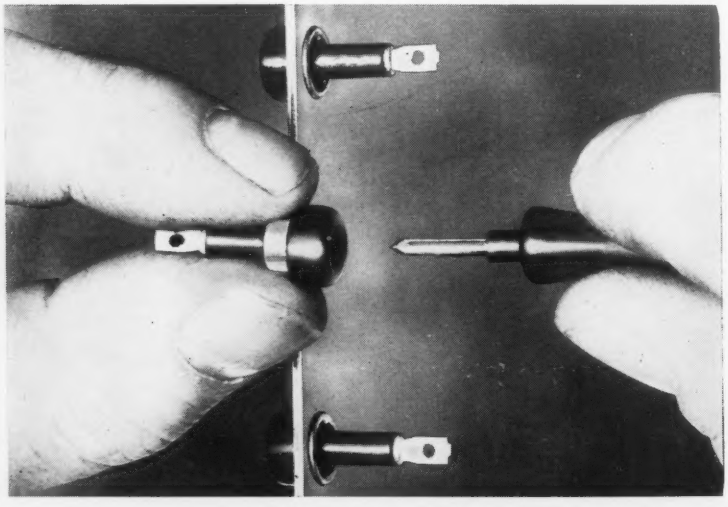
Cable wrapping

Spirally-cut tubing of insulating plastic, known as Spirap (Computer Control Company Inc.) for wrapping around wire bundles up to 2 in. diameter to eliminate tedious cable lacing.



Slave manipulators

The grips on this AMF Atomics Incorporated slave manipulator are precision aluminum castings with cemented foam rubber pads for conforming to contours.

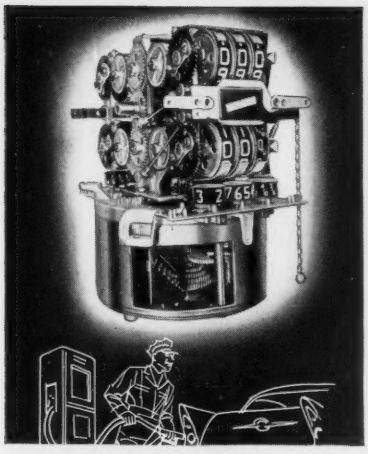


Eyelets for fast assembly

New low cost insulated miniature test jack with an integral molded eyelet (Alden Products Company) was designed specifically as a low cost approach for providing circuit checking points on equipment front panel, chassis and other parts. The first eyelet mounting cuts down assembly cost and does away with mounting nuts and washers.

Rubber-to-metal

A soft, non-porous rubber that can be vulcanized or securely bonded to metal has been developed by Roth Rubber Company. It can be used as an air tight seal or to absorb vibration and dampen noise.

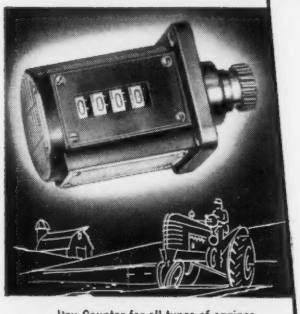


Computing Head for Gasoline Pumps

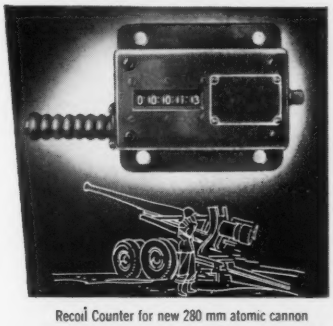
"Master Meter Duplicator" prints receipts for fuel oil delivered from trucks

"Vary-Tally" Multi-Unit Reset Manual Counter

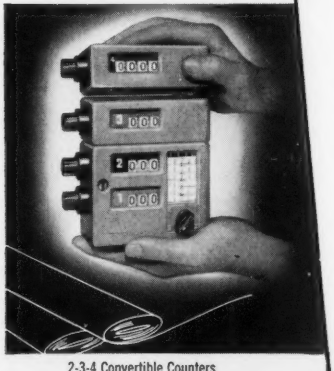
Everyone Can Count on VEEDER-ROOT



Kev-Counter for all types of engines



Recoil Counter for new 280 mm atomic cannon

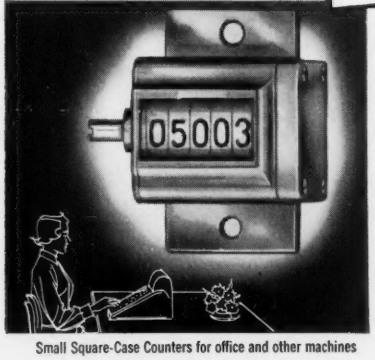


2-3-4 Convertible Counters (and others) for textile machinery

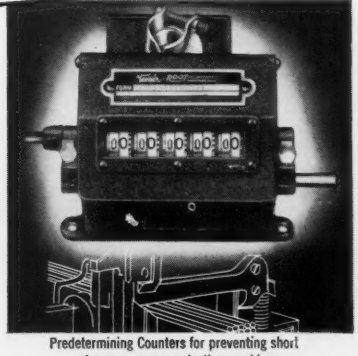
Everywhere you look in everyday life, you see a familiar face . . . the face of a Veeder-Root Counter or Computer. From gasoline pumps to fuel oil trucks to textile mills . . . in the home, on the farm, in business and commerce, in modern automated industry . . . Veeder-Root standard and special devices are keeping everything under *Count*rol . . . manually, mechanically, electrically. And the mathematical probabilities are mighty high that *you* can count on Veeder-Root, too . . . to your advantage and profit. Why not let us figure out how, *right now?*

VEEDER-ROOT OF CANADA LIMITED
955 St. James St., Montreal

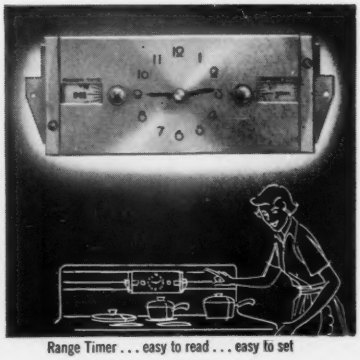
Fuel-Remaining Counter for aircraft . . . subtracts as fuel is used



Small Square-Case Counters for office and other machines



Predetermining Counters for preventing short and over-runs on production machines

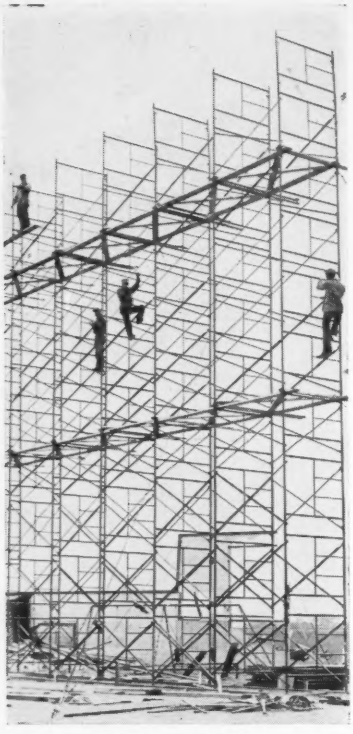


Range Timer . . . easy to read . . . easy to set

Main Office and Factory: Veeder-Root Inc., Hartford 2, Conn., U.S.A. • Factory in Dundee, Scotland • Offices and Agents in Principal Cities

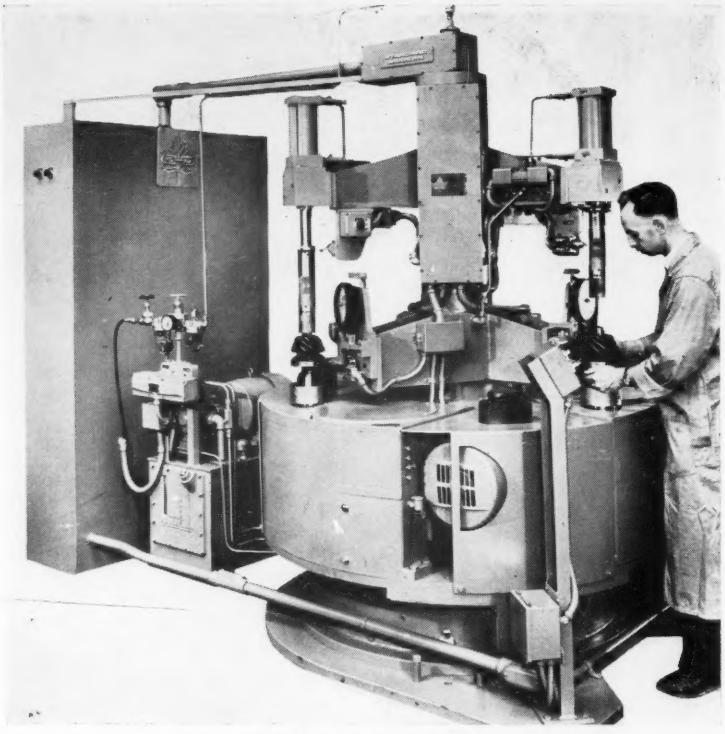
"The Name That Counts"

Some modern designs making news today



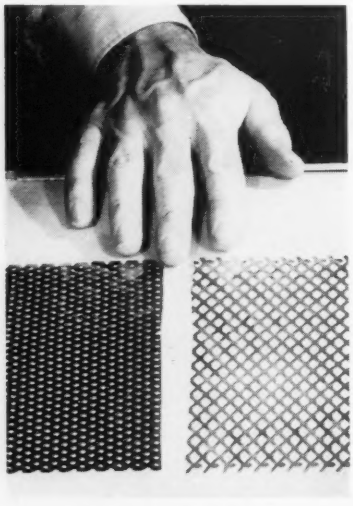
Tubular scaffolding

When a storm completely demolished the original screen at a drive-in theatre, this Waco scaffolding was used to build the new screen.



Bearing-torque machine

This machine, from Standard Modern Tool Company Limited, automatically preloads and torque tests the bearing locknut of the pinion shaft in an automobile rear end assembly. With narrow torque limits of 15 to 24 in.-lb the machine tightens the locknut, then checks the preload torque on tapered roller bearings during a five second run-in period.



Silver brazing alloys

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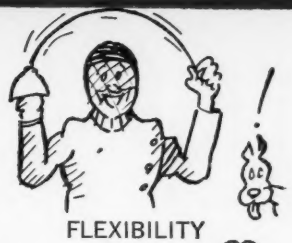

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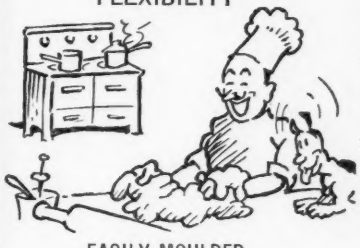

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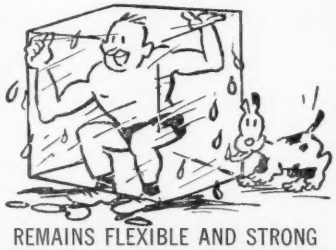

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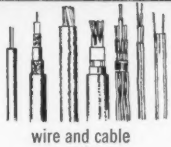

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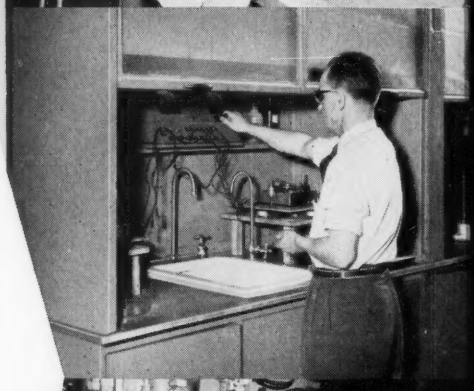

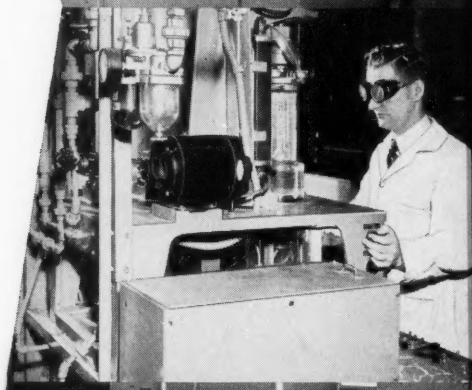

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2056—1

Cypak controls

(Continued from page 46)

contactless arm-actuated switch, (see figure 6) that has been developed specifically for Cypak applications. This switch operates as a result of the change of impedance produced in an encapsulated reactor when a permanent magnet moves near to the reactor or away from it. When the magnet is in position, the core is saturated, but when out of position, the core becomes unsaturated. This switch has only two points at which wear may occur, the main bearing and the roller bearing. Since there are no electrical contacts, the life of the switch can be expected to be many times that of conventional switches.

Still another switch is available for inclusion in the design. This new switch —the proximity switch shown in figure —has no moving parts and is, moreover, completely encapsulated. Like the contactless limit switch, the proximity switch makes use of the change in impedance that occurs when a normally saturated core becomes unsaturated. Normally, a magnet saturates the core but when a small steel bar approaches, flux is shunted away from the coil assembly. The resulting change in impedance is sufficient to provide a change in signal capable of operating Cypak control elements.

Any one of these three switches will be satisfactory for application. A decision will depend only upon the service life that is required. For these three switches, life ranges upward from 10 million operations to an indefinite value.

Once the limit switches have been selected, then it is possible to complete the logic circuit. Since there are several conditions in which it is necessary that operation may be stopped, a *Memory* circuit is now added to override other **On** signals. Also, since the stopping signal must control both up and down operations, both start and stop signals will be applied through **Or** circuits to the up and down circuits.

After means has been provided for stopping the drive motor, a means for starting it becomes the next objective. This is accomplished by the inclusion of an **Or** circuit to switch on the **Memory** circuit if normal up or down signals arrive.

One condition for stopping the drill head drive motor requires that during single cycle operation the motor will go through one full cycle and then stop when the drill head reaches the top position. This operation requires that three conditions be met: the circuit must be connected for single cycle operation; the drill head must be moving upward,

(Continued on page 70)

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Letters

Readers' viewpoints . . .

● I am interested in the article "Engineers Meet to Discuss Creative Design" in your May issue.

With regard to the forthcoming meeting of engineers to discuss this problem, if it is not too late, the undersigned and Mr. D. F. Parkhill would like to attend as we are extremely interested in creative design in the electronics industry especially.

I would be glad if you could please advise me when and where the meeting is to be held.

D. W. HOLDSWORTH
Manager,
Crosley Defence and
Electronics Division,
Toronto *Moffats Limited.*

This information was duly supplied and as a result, Messrs. Holdsworth and Parkhill attended the meeting.—Ed.

• • •

Interest in Eva

● You will notice that the letterhead shows that we rent, sell and service all kinds of tools and equipment which explains our interest in your article on the Evaporograph (nicknamed Eva) that appeared in the May issue of DESIGN ENGINEERING.

Often we are asked by fishermen, hunters and people spending their vacations in the country, about telescopes that would enable them to notice objects in the dark.

Your Eva seems to supply the answer, that is, if we knew a little more about it.

Therefore any further information on the subject would be appreciated.

E. MAUER
Montreal *Pres., Perco Limited*

We have told them where to get Eva and hope she makes for happy hunting.—Ed.

• • •

Eddy—current drive

● We have read with interest in the June issue of DESIGN ENGINEERING the article titled "A New Type Of Drive Comes From Canada."

We would like to obtain the mailing address of Tormag Transmissions Ltd.

N. CLEMENT
Montreal *Johnson & Johnson Limited*

• • •

● We read Mr. J. Nichols' article on the Tormag Transmission with extreme interest. We would like to consider this drive in a more practical light, and in order that we may take this step we would be favored if you could forward us the mailing address of Tormag Transmission.

G. MARTIN
Works Manager
The Dominion Road
Goderich, Ont. *Machinery Co. Ltd.*

The article on Tormag drives created quite a stir and many readers were so interested that they wrote us for the address.—Ed.

• • •

Ultrasonic testing

● Would you kindly put me in touch with Mr. M. J. Marko of the Non Destructive Testing Corporation, whose article "Let a Pulse Search Out the Defect" appeared in your April 1955 issue.

We wish to learn whether the equipment and techniques involved are applicable to an examination of brazed copper rotors for large induction motors.

E. G. BERGENSTEIN, P.ENG.,
Chief Engineer,
Reliance Electric and
Welland, Ont. *Engineering (Canada) Ltd.*

The value of Design Engineering for reference purposes is well shown by this letter dated June 14, 1956 about an article as far back as April, 1955 (the first issue, incidentally).—Ed.

• • •

Infra-red rays

● Have you a reprint of your excellent article in the May issue of Design Engineering? Could we have your permission to reproduce the 2 plates on page 30?

I have an article coming out in the August issue of the Canadian Medical Journal, with respect to the early diagnosis of breast cancer by measurement of heat emanation, which I am sure will be interesting to you, as a remarkable simplification of this problem is possible.

R. N. LAWSON
Surgeon
Montreal *4459 Sherbrooke St. W.*

• • •

Machine tool forum

● On page 76 of the June 1956 issue of DESIGN ENGINEERING reference is made to the 20th Westinghouse annual Machine Tool Electrification Forum (Cypak controls discussed).

Could you please tell the writer if the proceedings of this Forum are available, and if so, where they may be obtained?

Thank you for your assistance.

K. MCCLOSKEY
Canadian Radio
Toronto *Manufacturing Corp. Ltd.*

Cypak controls

(Continued from page 69)

with a connection established from the **Memory** to the **And** element; and the up limit switch must be operated. When these three conditions exist simultaneously the drill head drive motor will be switched off when the drill head is at its top position.

As the final step in circuit design, it is now necessary to provide a master stop push button for switching off the entire control. If the control is operating according to single cycle or repeat cycle operation, pressing the stop button will break the control circuit; the *Not* circuit prevents the resumption of operation when the stop button is released.

Once the logic circuit design is complete, it is obviously desirable to verify the circuit at this stage, well in advance of final assembly and test. An efficient way to accomplish this is through the use of a Cypak circuit simulator (see figure), an assembly of standard Cypak elements which can be interconnected by patch cords to build up any control system easily and quickly. Limit switches and pushbuttons are represented in the simulator by toggle switches.

To test the operation of the proposed control system, it is only necessary to operate selector switches after proper interconnections have been made. If the design under test is correct, indicator lights will glow in a pattern appropriate to the operating sequence of the machine.

After circuit verification, the next step is the transformation of the design into an actual operating control. Since the application chosen is intended for machine tool control, the requirements of the National Machine Tool Builders' Association and Joint Industries Conference are applicable and will be observed. To house the control equipment, specify a wall-mounted NEMA-12 cabinet that is gasketed to exclude oil, and also that door fasteners be of the quarter-turn type which require that a screwdriver be used to turn them.

As the final step in design, the panel layout is prepared (see figure). In this particular design, accessibility and conservation of cabinet space have received much attention. A new layout for the magnetic amplifiers contributes effectively to both objectives.

In summarizing the sequence followed in designing an automatic drill head control, progress has been made from the first interpretation of the control requirements to the final layout of the system. Although this particular application cannot represent all control problems, it does illustrate the basic elements that go into the Cypack system. ★

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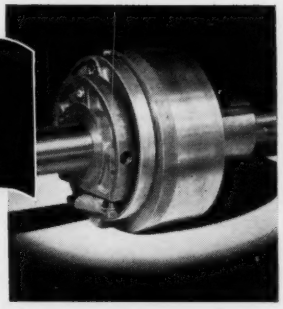

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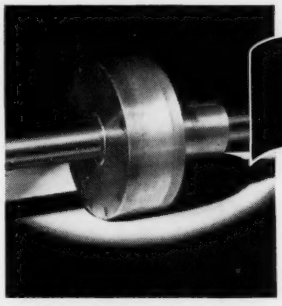

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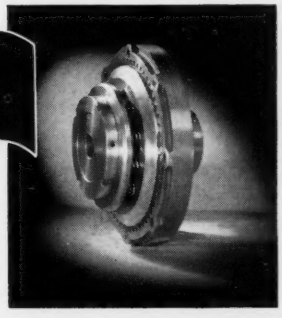

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Stroboscopes

(Continued from page 33)

the stroboflash. This instrument, however, has no built-in oscillator and has to be triggered from an external source, such as stroboflash, mechanical contractor, oscillator or any source of triggering pulses.

The lamp can be removed from the remainder of the unit, and a very large parabolic reflector makes possible floodlighting of large areas. This device can also be employed for single flash photography, provided a suitable external condenser is used.

To meet the requirements of the specialized application of the stroboscopic principle in the textile industry, mentioned before, a special model was built. Known as Stroboloom, it also employs a xenon-filled flash tube emitting an intense flash of white light of very short duration.

The instrument is synchronized with the machine motion by a contactor fitted with a remote control. The speed of the shuttle can be accurately determined by relating the shuttle position to stroboscopically determined angular settings of the driving shaft on the loom. For convenience of operation, the phase control is combined with the lamp assembly. Due to an extremely high intensity flash, the shuttle can be seen clearly in position, although the repetition rate may be only about 100 per minute. In order to obtain the longest possible life from the flash tube, the press switch is provided on the lamp handle adjacent to the phase control. The instrument enables the lay of the thread from behind the shuttle to be accurately determined at each stage of its progress through the warp shed, thus enabling the observer quickly to locate the development of a broken thread or other weaving defects caused by shuttle faults.

The power supply and triggering circuits are contained in a cabinet mounted on wheels and the remote control of the contactor enables the phase adjustment to be effected up to a distance of 12 ft. The duration of the flash is about 50 microsec, the maximum flashing rate being 220 per minute. The intensity of the flash is adequate for direct inspection under well lighted factory conditions, and the lamp has a color sensitivity approximating that of normal daylight.

The various types of stroboscopic device described are capable of solving nearly all the problems where the stroboscopic principle can be applied. A few other models are available, but these are actually simplified versions of the above to be used in cases where limited application is found to be necessary. ★

Don't miss the Canadian IRE Show

An excellent program of technical papers has been arranged for the Canadian Institute of Radio Engineers Convention & Exposition to be held in Toronto on October 1, 2, 3.

Subjects to be covered at the convention include: transistors; scatter propagation; medical electronics (for diagnosis and treatment); the application of electronics to atomic energy products; the use of computers in automation.

The purpose of the convention part of the exposition is to highlight Canadian developments in electronics and radio, stated Dr. George Sinclair, chairman of the Technical Program Committee. This will really be the first opportunity for Canadian engineers to describe to a widely representative audience of fellow countrymen the technical advances they have made. The alternative up until now has been to attend the New York show, but because this is the world's largest annual convention of engineers, the Canadian papers have been lost in the mass of material presented.

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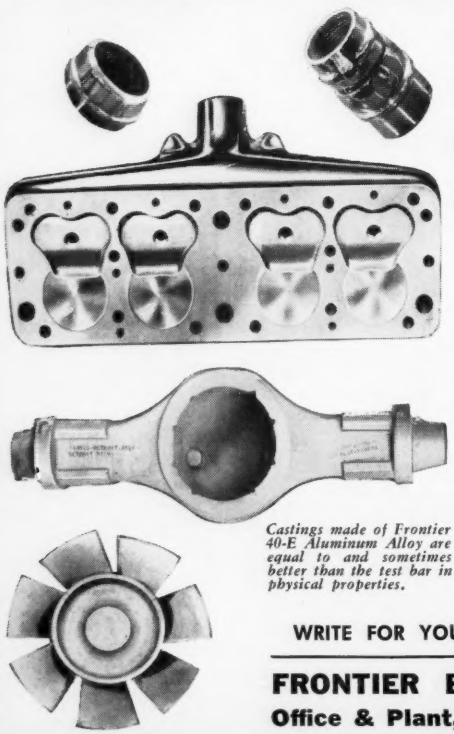

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Editorial

Let more engineers qualify

So acute is the shortage of technical personnel that a national conference on scientific and engineering manpower is to be held (see Reports page) early in September at St. Andrew's-by-the-Sea, New Brunswick.

The conference will be under the chairmanship of Crawford Gordon, Jr., President and General Manager of A. V. Roe, Canada Ltd., and will be attended by representatives of the government, the professional societies, education, labor and industry. It aims to find a solution to the existing shortage of scientists, professional engineers and skilled mechanics, and has been hailed as one of the first real moves towards increasing the supply of engineers in Canada.

Why not do it like this?

As is well known, the cost of university education is beyond the means of many would-be students and one way to increase the number of trained personnel might be to institute a scheme similar to that used in the British Isles. There it is possible, for example, to take an external degree at London University. The student enrols at a recognized technical college, not necessarily anywhere near the London area, either as a full or part-time day student or in the evening (he can even study by correspondence) and then sits for the actual examination at one of a number of recognized centres.

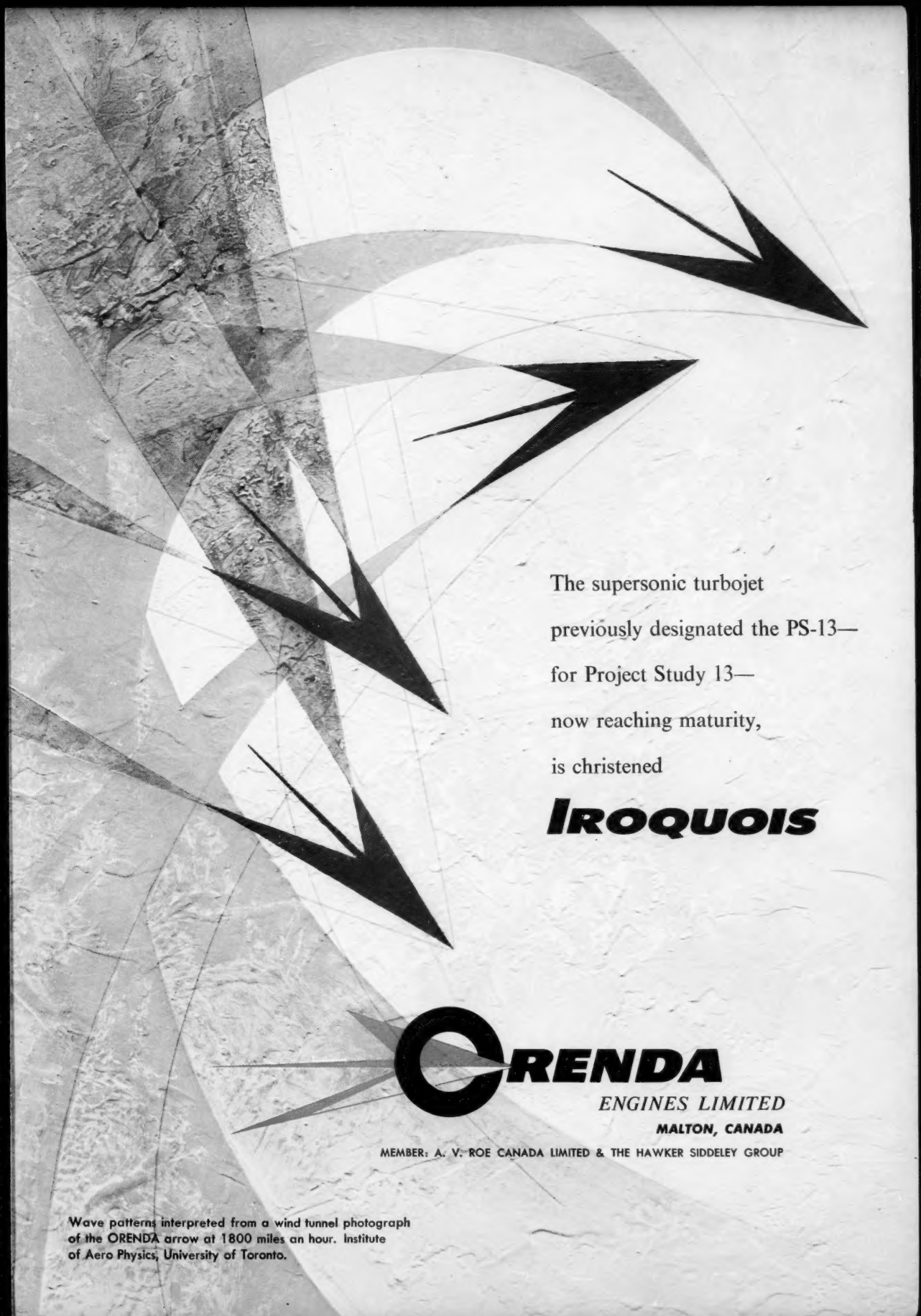
Another approach would be to adopt the National Certificate scheme. There are two grades, the ordinary (ONC) and the higher (HNC), the latter being on a par with a degree. Many successful engineers, by studying at evening classes after a day's work, have obtained their HNC, a qualification highly thought of and well worth having.

Still another approach would be to encourage young engineers to take the examination of one of the societies, such as the Institution of Mechanical Engineers or the Institution of Electrical Engineers. Eligibility for associate membership then follows after a specified minimum number of years of practical experience.

It seems that the qualifications of would-be-engineers are too restricted as at present constituted in Canada. Increased technical manpower would most certainly result if the present facilities were extended on the lines outlined above.

These suggestions are at any rate made in the sincere hope that they will be of some assistance to the members of the forthcoming conference in the difficult task that lies ahead of them.

William Morse.



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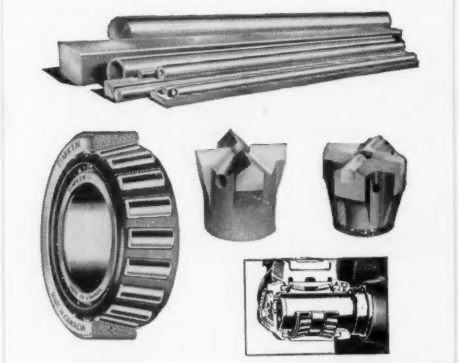
You mean what you say, when you say "TIMKEN"

IF you are content with just any old kind of tapered roller bearing, steel or rock bit, of course you don't specify "Timken". By the same token, when you want highest quality you don't specify anything *but* "Timken". To make sure you get what you want—to safeguard your reputation and ours—we stamp "Timken" on every product we make. When you say "Timken" we know you *mean* a product made by the Timken Company . . . because, as everyone is aware, "Timken" is a trade-mark, not *just a type of product.*

When you purchase tapered roller bearings, alloy steel bars, seamless steel tubing or removable rock bits, always look for this famous legal identification. When you see it, you know there are over 55 years of experience behind it. When you *say* it, you're saying exactly what you mean: "I want the best." The Timken Roller Bearing Company, Canton 6, Ohio, U. S. A. **CANADIAN PLANT:** St. Thomas, Ontario. Cable address: "TIMROSCO".



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TAPERED ROLLER BEARINGS

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